The Dissertation Committee for Andres Jose Vargas
certifies that this is the approved version of the following dissertation:

The Labor Market Impacts of Social Security Contributions:

Lessons from Colombia

Committee:

_____
Stephen J. Trejo, Supervisor

_____
Daniel S. Hamermesh

_____
Gerald S. Oettinger

_____
Daniel T. Slesnick

_____
Jacqueline L. Angel

The Labor Market Impacts of Social Security Contributions: Lessons from Colombia

by

Andres Jose Vargas, B.A.; M.A.; M.S.

Dissertation

Presented to the Faculty of the Graduate School of

the University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

August 2006

Dedication

To Ximena,

whose love and support has made graduate school an enjoyable experience.

To my mother,

whose example inspired me to pursue a Ph.D.

To my grandparents,

who, as role models, taught me the importance of commitment and hard work.

Acknowledgements

I am indebted to my adviser, Stephen Trejo, for his insightful and valuable feedback. I am also grateful to Daniel Hamermesh, Gerald Oettinger, Daniel Slesnick, Jacqueline Angel, Adriana Kugler, and Stefano Farne for their useful suggestions. I am thankful to Cesar Caballero and Alejandra Corchuelo, from the Colombian National Department of Statistics DANE, for providing me with the data. Finally, I would like to thank seminar participants at The University of Texas at Austin, The Second Conference on Aging in the Americas (SCAIA), and Texas Tech University for their important comments.

Andres Jose Vargas
August, 2006

The Labor Market Impacts of Social Security Contributions: Lessons from Colombia

Publication No._____

Andres Jose Vargas, Ph.D.

The University of Texas at Austin, 2006

Supervisor: Stephen J. Trejo

This dissertation contributes to the literature on social security by estimating the effects of this payroll tax on several labor market outcomes in Colombia, and by evaluating how these effects vary according to the workers' valuation of the benefits. Colombia provides an interesting case study because the country implemented a social security reform in 1993 that increased the payroll tax rate by over 10 percentage points and improved both quantity and quality of benefits. To identify the effects of this reform I use cross-sectional data from the Colombian National Household Survey for the years 1984 to 1996. In the first chapter, I analyze the relationship between social security taxes and the employment sector choice of workers. I find that the reform increases the proportion of females employed in the formal sector of the economy, defined as the sector that complies with social security regulations, by 6 percentage points while it increases males' formal employment probability by only 3 percentage points. In the

second chapter, I estimate what fraction of social security contributions employers pass on to workers in the form of lower hourly wages. My results show that the wages of females (males) in the formal sector decrease (increase) by 5% (2%) relative to the wages of those in the informal sector. In the third chapter, I examine the effect of social security contributions on weekly hours worked. My findings indicate that the reform reduces the work of women in the formal sector by 2 hours relative to the hours worked by those in the informal sector, whereas it does not have a significant impact on the hours worked by men. The effects of the reform on wages and hours are particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effects are insignificant. The patterns of how the effects vary across demographic groups are theoretically consistent, within a model of employment sector choice, with the link between the magnitude of the effects and the workers' valuation of the social security benefits.

TABLE OF CONTENTS

Introduction

This dissertation contributes to the literature on social security by estimating the effects of this payroll tax on several labor market outcomes in Colombia, and by evaluating how these effects vary according to the workers' valuation of the benefits. Although I do not observe this valuation directly, I believe that headship, parenthood, and marital status are good proxies for it. Colombia provides an interesting case study because contributions for pension and health care provisions amount to a quarter of the wage bill there. This, in conjunction with an 11% average contribution for other payroll taxes, positions Colombia as the country with the highest payroll tax rate in Latin America. Furthermore, the Colombian social security reform of 1993, which transformed the institutional framework for pension funds and health care provisions, constitutes a large exogenous change that allows me to identify the effects of these contributions. This reorganization increased the payroll tax rate by over 10 percentage points and improved both quantity and quality of benefits. The comparison of the effects of this reform with other Latin American experiences, such as the ones in Chile and Mexico, constitute an important reference point for policy makers in developed and developing countries. To estimate the impacts of this change, I use cross-sectional data from the Colombian National Household Survey for the years 1984 to 1996.

The first chapter of my dissertation analyzes the relationship between social security taxes and employment sector choice. The contribution of this chapter is twofold. First, I study here the effects of a benefit-linked payroll tax given that there is a connection

between the taxes paid by or on behalf of each worker and that individual's expected benefits, whereas previous empirical studies analyzed the effects of general payroll taxes that have no linkage to benefits for the individual taxpayer. Second, in this study I consider a large fraction of the wage–and-salary sector that evades payroll taxes, while most of the literature on tax policy and employment sector choice focuses on industrialized economies and only considers the transition between a wage-and-salary job and self employment.

In this chapter I estimate a multinomial logit model of the probability that a worker belongs to any of four employment sectors: formal, wage-and-salaried informal, self employment, and non-market participation. I find that the reform generates a 6 percentage point increase in females formal employment probability, a 2.5 percentage point reduction in both self employment and non-market participation, and a 1 percentage point fall in salaried informality. On the other hand, the reform increases males' formal employment probability by only 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment by 0.7 percentage points, and has an insignificant effect on non-market participation. Although the pension and health care reforms both generate an increase in formality in the aggregate, they have a differential impact on the sectoral composition of employment across family structure groups. Among females, my results show that for married women the reform is the basis for a transition from non-market participation and self employment into formality, especially for those with young children. Conversely, for single head-of-household and single

dependent women the reform causes, in addition to the previous changes, a shift from salaried informality into formality.

In the second chapter of my dissertation, I adopt a difference-in-difference approach to estimate what fraction of social security contributions employers pass on to workers in the form of lower wages. My work extends the literature by (1) estimating how this effect varies according to the workers' valuation of the benefits, (2) considering a broad set of economic activities and occupations, and (3) controlling for the omitted variable bias arising from unobserved heterogeneity. My results indicate that the hourly wages of female workers with access to social security benefits decrease by 5% relative to the wages of those without access to the benefits. In contrast, the hourly earnings of male workers in the wage-and-salary formal sector increase by 2% relative to the earnings of those in the wage-and-salary informal sector. The reduction in the relative wages of formal sector workers is particularly important among married mothers and single head-of-household women, whereas for married women without young children, single dependent women, and men in any family structure group the effect is not significantly different form zero.

Finally, the third chapter of my dissertation focuses on the effect of social security contributions on hours worked. I concentrate on prime age workers and investigate how variations on the valuation of the benefits across family structure groups affect the estimates. I find that the social security reform has a negative effect on the hours of work of women in the formal sector, reducing their weekly work by 2 hours relative to the

weekly work of those in the informal sector of the economy. This effect is particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effect is not statistically significant. The effect on women is mostly explained by a reduction in the proportion of females that work part-time in the informal sector, who switched to full-time jobs in the formal sector in order to get access to social security benefits for themselves and their families.

The patterns of how the estimated effects of the reform on employment, wages, and hours of work vary across demographic groups are consistent with the theoretical link between the magnitude of the effects and the workers' valuation of the social security benefits. Furthermore, these findings are theoretically consistent with a model of employment sector choice where the effect of the higher valuation of social security benefits dominates the impact of the increased contributions.

Chapter 1: The Impact of Social Security Contributions on Employment Sector Choice.

1.1 Introduction

Individuals can alter their employment decisions to avoid paying taxes. Consequently, an increase in a payroll tax could change the workers' choice of employment sector. In this chapter I study how social security contributions promote or discourage informal employment, defined as employment in an underground sector that does not comply with labor and social security regulations, and I determine for whom such incentives have the largest effects. I analyze in particular the impact of pensions and health care contributions on the choice of employment sector in Colombia.

Most of the literature on taxes and employment choice has focused on income taxes and their effect on self employment in industrialized economies.[1] Early time series and cross-sectional literature generally concludes that higher tax rates produce higher levels of self employment, supporting the notion that individuals become self-employed to avoid paying higher wage-and-salary taxes. However, Schuetze and Bruce (2004) point out that the latest studies that use panel data have found no conclusive evidence on the effects of taxes on self employment. They argue that, among other factors, the effect depends on the structure of the tax system and whether the increase in tax rates is accompanied by a change in the progressivity of the tax schedule.

[1] See Schuetze and Bruce (2004) for a detailed survey of the literature on tax policy and entrepreneurship.

The contribution of this chapter is twofold. First, I study here the effects of a benefit-linked payroll tax given that there is a connection between the taxes paid by or on behalf of each worker and that individual's expected benefits, whereas previous empirical studies analyzed the effects of general payroll taxes that have no linkage to benefits for the individual taxpayer. Second, in this study I consider a large fraction of the wage–and-salary sector that evades payroll taxes, while most of the literature on tax policy and employment sector choice focuses on industrialized economies and only considers the transition between a wage-and-salary job and self employment.

Colombia provides an interesting case study because contributions for pension and health care provisions amount to a quarter of the wage bill there. This, in conjunction with an 11% average contribution for other payroll taxes, positions Colombia as the country with the highest payroll tax rate in Latin America. Furthermore, the Colombian social security reform of 1993, which transformed the institutional framework for pension funds and health care provisions, represents a large exogenous change that allows me to identify the effects of these contributions. The comparison of the effects of this reform with other Latin American experiences, such as the ones in Chile and Mexico, constitutes an important reference point for policy makers in developed and developing countries.

The end of the 1980's and early 1990's was a period of deep structural transformations in Latin America. These reforms were part of efforts to liberalize economies and increase the participation of the market in the production and allocation of goods and services, and were the product of the collapse most economies experienced

during the 1980's due to their mounting fiscal and monetary imbalances.[2] In Colombia, the main reforms during this period included the approval of a new constitution, key reforms to the labor market, a major trade reform, and liberalization in direct foreign investment.

Three years after these reforms were put in place Colombia implemented a social security reorganization that transformed the institutional framework for pension funds and health care provision (Law 100 of December 1993). Regarding the health care regime, the reform replaced the existing discretionary affiliation system that covered only the worker, with a mandatory one that features a stricter prepayment system and also covers the spouse and children or the parents of the worker. On the subject of pensions, the reform introduced a fully funded social security system, giving workers the choice between the traditional benefit defined in the existing pay-as-you-go scheme, and the new one of individual capitalization of public funds. The greater benefits also brought along an increase in employees and employers' pension and health care contributions, raising the payroll tax rate by over 10 percentage points.

In this chapter I hypothesize that the effect of these reforms on employment sector choice is determined by the workers valuation of the benefits financed by the social security contributions. Although I cannot measure this valuation directly, I believe that marital and headship status and the presence of young children in the household are good

[2] Heckman and Pages (2003).

proxies for this valuation.[3] Consequently, I analyze the effect of the social security reform by categorizing agents according to their family structure type and evaluating for each category how the probability of belonging to a given employment sector changes from before to during and after the reform.

For each demographic group I estimated a multinomial logit model of the probability that a worker belongs to any of the following employment sectors: formal, wage-and-salaried informal, self employment, and non-market participation. I find that a 10 percentage point increase in payroll taxes accompanied by an improvement in the quality and quantity of the benefits, generates a 6 percentage point increase in females formal employment probability, a 2.5 percentage point reduction in both self employment and non-market participation, and a 1 percentage point fall in salaried informality. On the other hand, the reform increases males' formal employment probability by only 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment by 0.7 percentage points, and has an insignificant effect on non-market participation.

Although the pension and health care reforms both generate an increase in formality in the aggregate, they have a differential impact on the sectoral composition of employment across family structure groups. The pension reorganization has a relatively higher positive impact than the health care reform on the probability of formal employment for single workers, while the opposite occurs for married workers,

[3] DeLeire and Levy (2004) use a similar strategy in their study of working sorting across occupations in response to the risk of death on the job.

regardless of the gender group considered. In particular, I find that for married women the health care reform is the basis for a transition from non-market participation and self employment into formality, especially for those with young children. In contrast, for single head-of-household and single dependent women the pension reform is the major cause of the shift from salaried informality, self employment, and non-market participation into formality. Regarding males, the pension reform shifts employment from salaried informality into self employment for single head-of-household men, and from salaried informality into formality for single dependants. Conversely, the health care reform reallocates married men from self employment into formality, and shifts single head-of-household and non-single dependent males from salary informality and self employment into formal employment.

These findings contradict earlier literature on general payroll taxes that commonly concludes that higher tax rates generate higher levels of employment in the non-taxed sector. It is theoretically consistent, however, with a model of employment sector choice where the effects of the higher valuation of social security benefits and tighter link between benefits and contributions dominate the impact of the augmented contributions. Furthermore, the patterns of how these estimated effects vary across family structure groups are consistent with the theoretical link between the magnitude of the effects and the agent's valuation of the benefits.

I proceed by presenting in the next section a brief description of the social security reform in Colombia. In Section 1.3, I introduce an equalizing differences model of

employment choice that will serve to interpret the empirical results. In Section 1.4, I present the data and descriptive statistics and continue in Section 1.5 with a discussion of the empirical specification and the results. Section 1.6 concludes and outlines some directions for future research.

1.2 The Colombian Social Security Reform of 1993

The social security reform of 1993 transformed the institutional framework for pension funds and health care provision. Under the old health care system 15% of the population was covered by the public Social Security Institute (ISS), an additional 15% could afford private health care or was covered by alternative services, and the remaining 70% did not have any access to proper health care services.[4] The reorganization aimed to increase the quality and coverage of the system by implementing a regime based on competition among insurance administrators and health care providers. The reform replaced the existing social insurance system, which was in practice a last-resort individual health insurance mainly used by poor workers or higher income people with elevated health care costs, with a mandatory one with a stricter prepayment program that covers also the family of the worker and provides a choice between services.

The reform also generated an increase in social security payroll taxes. The Table 1 shows that health care contributions increased gradually from 7% in 1992, to 8% in April 1994, and 12% in 1996.[5] The employer must pay two thirds of these contributions,

[4] Farne (2003)
[5] The final increase actually occurred in January 1995.

whereas the workers only pay one third. Consequently, the reform raised employer and employees' contributions by 3.3 and 1.7 percentage points, respectively.

Regarding pensions, the reform introduced a fully funded social security system giving the workers the choice between the benefit defined in the existing pay-as-you-go system, and the new one of individual capitalization of public funds in which pension benefits depend upon fund performance. As shown in Table 1, pension contributions increased gradually over a three-year period from 8% in 1992, to 11.5% in April 1994, to 13.5% in January 1996.[6] The employer must pay three fourths of the pension contributions and the workers the remaining one fourth. Consequently, the reform raised employer contributions by 4.84 percentage points, while it augmented employees' contributions only by 0.67 percentage points.

Table 1

Mandatory NonWage Labor Costs

Percentage of Basic Wages (1)

	Pre-reform Rates (1992)			**During-reform Rates (1994)**			**Post-reform Rates (1996)**		
	Employer	Employee	Total	Employer	Employee	Total	Employer	Employee	Total
Social Security Contributions	**11.99**	**5.01**	**17.00**	**15.96**	**5.54**	**21.50**	**20.13**	**7.38**	**27.50**
Pensions (2)	5.29	2.71	8.00	8.63	2.88	11.50	10.13	3.38	13.50
Health	4.70	2.30	7.00	5.33	2.67	8.00	8.00	4.00	12.00
Professional Risks (3)	2.00	-	2.00	2.00	-	2.00	2.00	-	2.00
Other Payroll Taxes	**9.00**	**-**	**9.00**	**9.00**	**-**	**9.00**	**9.00**	**-**	**9.00**
Labor Training	2.00	-	2.00	2.00	-	2.00	2.00	-	2.00
Social Assistance Programs	3.00	-	3.00	3.00	-	3.00	3.00	-	3.00
Family Subsidy	4.00	-	4.00	4.00	-	4.00	4.00	-	4.00

Source: Law 100 of 1993, Decree 685 of 1994, Decree 2926 of 1994, Lora and Henao (1997), Lopez(2003).

(1) Before the Law 100 of 1993 the basic wage used to calculate the contribution included a commuting subsidy for workers earning the minimum wage, but it does not include it thereafter.

(1) There is a 1 percent extra contribution for workers earnings more than 4 minimum wages

(2) The rate oscillates between 0.348% and 8.7% according to the degree of risk associated with the economic activity of the firm, its work injury rate, and its prevention programs The average is 2%.

[6] Although not shown in Table 1, pension contributions increased to 12.5% in January 1995.

Employers also have to make contributions to the General System of Professional Risks that covers health care expenses and gives economic compensations in the event of a work related accident or illness. The average contribution rate is 2% and it oscillates according to the degree of risk associated with the economic activity of the firm, its work injury rate, and its prevention programs. These contributions are supplementary to other payroll taxes that were originally established to finance different forms of social security such as the National Apprenticeship Service (SENA), the Colombian Family Welfare Institute (ICBF), and the Family Compensation Funds. As seen in Table 1, these additional taxes over the wage bill amount to 9% of basic wages, but were not changed by the social security reform.[7]

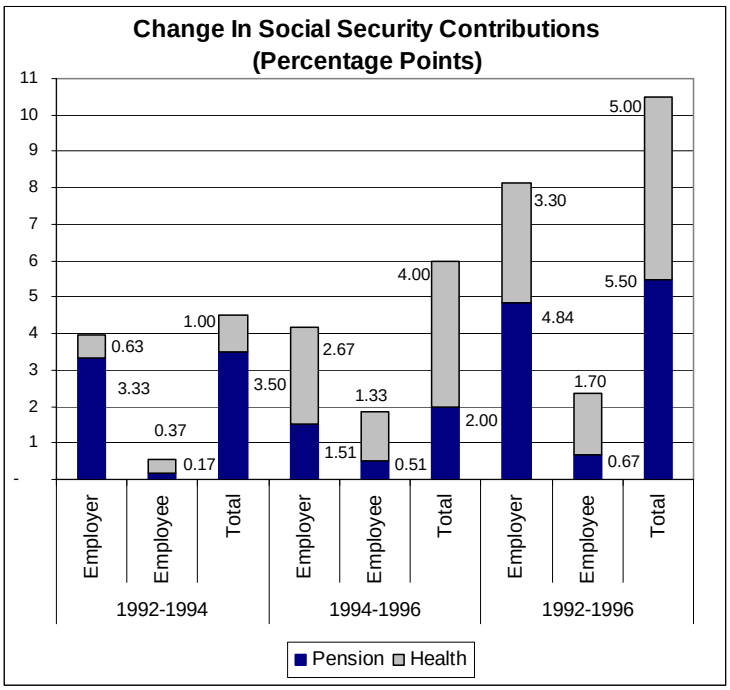
To summarize, the social security reform gradually increased the statutory pension and health care contributions by 10.5 percentage points. Figure 1 shows that the total increase in pension contributions was 5.5 percentage points, slightly greater than the 5 percentage point increase in health care contributions. In addition, it shows that during the 1992-1994 period the increase in contributions was mainly due to pensions, while during the 1994-1996 period the increase was mostly explained by health care payments. Finally, Figure 1 shows that the statutory increase in employer social security contributions was 3.5 times that of the increase in employees' contributions.

The higher contributions were related to an increase in the quality and quantity of the benefits. For pensions, social security contributions were more closely related to benefits

[7] For a detailed analysis of these payroll taxes in Colombia see Alm & Lopez (2002), and Lopez (2003).

for workers who changed to the individual capitalization system. Health-related social security contributions before the reform constituted in practice a last-resort individual health insurance but turned into a prepaid system that covers also the families and provides a choice between services.

Figure 1



Source: Law 100 of 1993, Decree 685 of 1994, Decree 2926 of 1994, Lora and Henao (1997), Lopez (2003).

1.3 An Equalizing Differences Model of Employment Choice

This theoretical model considers a formal sector covered by social security regulations that coexists with an informal or unprotected sector that evades them, in an economy where wages are competitively determined. To model this kind of market I extend Rosen's (1986) equalizing differences model in two ways. First, I allow for

benefit-linked payroll taxes to be levied on workers and firms in the formal sector. Second, I consider compliance with social security regulations as a productive amenity.

As in Rosen (1986), I assume that workers have homogeneous skills and heterogeneous preferences defined over market consumption goods and social security benefits. Some jobs comply with the social security regulations and therefore have an amenity present, while some others evade the regulations offering jobs without the amenity. Define $\varepsilon_i \in (0, \overline{\varepsilon})$ as the necessary compensation to make worker i indifferent between a job that provides social security benefits and a job that doesn't. This compensating variation depends on the extent to which employees value the access to social security benefits. If worker i does not value the amenities received through social security, then $\varepsilon_i = 0$. On the other hand, if the employees value the access to social security benefits they will require a compensation to relinquish those amenities and $\varepsilon_i \geq 0$. The population density of ε_i is given by $f(\varepsilon / \theta)$, which I assume to be continuous with mean θ and variance-covariance matrix Ω.

Now allow for benefit linked payroll taxes to be levied on workers and firms in the formal sector. Define the competitively determined wages in the formal and informal sectors as w_F and w_I, respectively; the payroll tax on firms as t_f; and the tax rate on workers as t_e, such that the total payroll tax equals to $T = t_e + t_f$. With these definitions in hand, let us define $\Delta\hat{w} = w_I - w_F + t_e = \Delta w + t_e$ as the workers' after tax market wage differential between the informal and formal sector. Each individual applies to a job at

which his/her utility is maximized. Accordingly, worker i chooses the formal sector if and only if the necessary compensation to make him/her relinquish the social security benefits is greater than the actual after tax market wage differential between the informal and the formal sector: $\varepsilon_i > \Delta\hat{w}$. Correspondingly, worker i chooses the informal sector if $\varepsilon_i < \Delta\hat{w}$ and it is indifferent between the two types of jobs if $\varepsilon_i = \Delta\hat{w}$ (see Figure 1.a in the Appendix).

The supply of labor to each job type depends on $\Delta\hat{w}$ but not on w_I, w_F, t_e, t_f independently. If N is the number of agents in the economy, the supply of workers in the formal and informal sector is respectively given by:

$$L_F^s = \int_{\Delta\hat{w}}^{\bar{\varepsilon}} Nf(\varepsilon/\theta)d\varepsilon = N(1-F(\Delta\hat{w})); \quad \frac{dL_F^S}{d\Delta w} = -Nf(\Delta\hat{w}) \le 0 \; ; \quad \frac{dL_F^S}{dt_e} = -Nf(\Delta\hat{w}) \le 0 \qquad (1)$$

$$L_I^s = \int_0^{\Delta\hat{w}} Nf(\varepsilon/\theta)d\varepsilon = N(F(\Delta\hat{w})); \quad \frac{dL_I^S}{d\Delta w} = Nf(\Delta\hat{w}) \ge 0; \quad \frac{dL_I^S}{dt_e} = Nf(\Delta\hat{w}) \ge 0 \qquad (2)$$

One obtains the supply function for each sector by specifying the distribution $f(\varepsilon_i/\theta)$ and integrating over the appropriate region.

Regarding the labor demand, firms have to choose the job type offered to the market according to their technology and wages. They compare the benefits of belonging to the formal sector in terms of a higher productivity, to the greater after tax cost of complying with labor and social security regulations. The benefits of formality are potential productivity gains since firms in the informal sector must restrict their size and location to avoid detection by the regulatory agencies. Furthermore, the provision of health care

benefits can potentially make workers in the compliant sector healthier and more productive. I model this by assuming that firms in the formal sector are at least as productive as firms in the informal sector; therefore, that compliance with the regulations is a productive amenity. If workers demand a wage premium to work without social security benefits, then a firm will never find it in its self interest to offer such jobs unless there where compensating advantages to its profitability. The advantage for firms in the informal sector is the evasion of social security contributions, other payroll taxes, and costly regulations not directly linked with benefits to the worker.

Formally, consider a linear production function and define a_i^j as the value of the marginal product of labor of firm j in sector i. In addition, recall t_f as the total payroll tax on firms including social security contributions. With these definitions in hand define $A^j = (a^j{}_{\mathrm{F}} - a^j{}_{\mathrm{I}}) \in (0,\overline{a})$ as the gain in productivity for belonging to the formal sector. Let A^j have a probability density function $g(A/\gamma)$ that incorporates the size of each firm as well as its technology. I assume this distribution to be continuous with mean γ and variance covariance matrix Ψ.

In addition, let us define $\Delta\tilde{w} = t_f - (w_I - w_f) = t_f - \Delta w \geq 0$ as the firms' after tax market wage differential between the formal and the informal sectors. This difference can be seen as the compensating advantage to the profitability of firms in the informal sector and is assumed to be positive. Then, a firm chooses the formal sector if and only if the gain in productivity obtained for choosing this sector, A^j, is greater than the total tax cost

of belonging to the formal sector, t_f, minus the wage premium the firm would have had to pay to workers in the informal sector, Δw. That is : $A^j > \Delta\tilde{w}$. Alternatively, the firm chooses the informal sector if the cost of belonging to this sector in terms of the lost in productivity, A^j, plus the wage premium, Δw, is lower than the benefits of tax evasion, t_f. That is: $A^j < \Delta\tilde{w}$. The firm is indifferent between the two types of jobs if $A^j = \Delta\tilde{w}$ (see Figure 1.a in the Appendix).

If the total demand for labor is fixed at N, the relative demands of labor in the formal and informal sectors are given by:

$$L_F^D = \int_{\Delta\tilde{w}}^{\bar{a}} Ng(A/\gamma)\, dA = N(1-G(\Delta\tilde{w}));\ \frac{dL_F^D}{d\Delta w} = Ng(t_f - \Delta w) \geq 0;\ \frac{dL_F^D}{d\Delta t_f} = -Ng(t_f - \Delta w) \leq 0 \quad (3)$$

$$L_I^D = \int_0^{\Delta\tilde{w}} Ng(A/\gamma)\, dA = N(G(\Delta\tilde{w}));\ \frac{dL_I^D}{d\Delta w} = -Ng(t_f - \Delta w) \leq 0;\ \frac{dL_I^D}{dt_f} = Ng(t_f - \Delta w) \geq 0 \quad (4)$$

One obtains the demand function for each sector by specifying the distribution $g(A/\gamma)$ and integrating over the appropriate region.

As in the Rosen (1986) model, fixing the total number of workers to be assigned is what justifies working with the wage differential alone. The total number of people employed and the size distribution of firms is a function of the absolute level of after tax real wages, and a general equilibrium model would determine both of them. Nevertheless, this goes beyond the scope of this chapter and is taken as exogenous here. In this model the wage differential between the informal and the formal sector, $\Delta w = w_I - w_F$, is going to adjust such that the relative supply and demand of

workers in each job type equalize. As seen in equations (1) and (3) the relative supply of informal labor is increasing in Δw and the relative demand for informal labor is decreasing in Δw, so the standard stability conditions for market equilibrium are met and the equilibrium is unique. In equilibrium Δw adjusts to make:

$$L_F^* = (1 - F(\Delta w^* + t_e)) = (1 - G(t_f - \Delta w^*)) \; ; \quad L_I^* = F(\Delta w^* + t_e) = G(t_f - \Delta w^*) \qquad (5)$$

Figure 1.a in the Appendix shows a graphic representation of the equilibrium. As mentioned earlier, compliance with the social security regulation is a productive amenity. Consequently, there is a tendency toward positive assortive matching in equilibrium. Workers that have the highest valuation of social security benefits, ε_i, are matched with firms with the highest gain of compliance with regulations in terms of the productivity increase, A^j. The Colombian social security reform increased both employees' and employers contributions, strengthened the link between contributions and benefits, and augmented the worker's valuation of the benefits of compliance. In what follows I use the equilibrium condition (5) to analyze the effect of such reforms on the equilibrium wage differential and the relative level of formal employment.

i. Increase in Employees' Contributions: A rise in the worker's social security contributions reduces the relative supply of labor in the formal sector. Holding constant the workers' valuation of the benefits, this decreases both the equilibrium wage differential and level of formal employment. Formally:

$$\frac{d\Delta w^*}{dt_e} = -\frac{f(\Delta\hat{w})}{f(\Delta\hat{w}) + g(\Delta\tilde{w})} \in (-1,0) \Rightarrow \frac{d\Delta\hat{w}}{dt_e} \geq 0 \Rightarrow \quad (6)$$

$$L_F^{**} = (1 - F(\Delta w^{**} + t'_e)) = (1 - G(t_f - \Delta w^{**})) \leq L_F^* = (1 - F(\Delta w^* + t_e)) = (1 - G(t_f - \Delta w^*))$$

ii. Increase in Employers Contributions: A rise in the firms' social security contributions reduces the labor demand in the formal sector. Ceteris paribus, this increases the equilibrium wage differential and reduces the level of formal employment. That is:

$$\frac{d\Delta w^*}{dt_f} = \frac{g(\Delta\tilde{w})}{f(\Delta\hat{w}) + g(\Delta\tilde{w})} \in (0,1) \Rightarrow \frac{d\Delta\tilde{w}}{dt_f} \geq 0 \Rightarrow \quad (7)$$

$$L_F^{**} = (1 - F(\Delta w^{**} + t_e)) = (1 - G(t'_f - \Delta w^{**})) \leq L_F^* = (1 - F(\Delta w^* + t_e)) = (1 - G(t_f - \Delta w^*))$$

iii. Increase in valuation of the benefits: Recall that ε_i is the necessary compensation to make worker i indifferent between a job that provides social security benefits and a job that doesn't. Consequently, it depends on the benefit linkages of the contributions and the worker's valuation of the social security benefits. A generalized augment in this valuation increases the value of $\varepsilon_i \forall i$ and therefore changes the distribution of ε_i. The new cumulative distribution $\mathrm{F}_2(\varepsilon)$ gives less weight to the low valuation levels relative to the old distribution $\mathrm{F}_1(\varepsilon)$. Explicitly, the new distribution is such that $\forall \varepsilon\ \mathrm{F}_2(\varepsilon) \leq \mathrm{F}_1(\varepsilon)$, that is, $\mathrm{F}_2(\varepsilon)$ first order stochastically dominates $\mathrm{F}_1(\varepsilon)$. This in turn translates into an increase in the supply of labor in the formal sector $L_{2F}^s = N(1 - F_2(\Delta\hat{w})) \geq L_{1F}^s = N(1 - F_1(\Delta\hat{w}))$ (see Figure 2.a. in the Appendix). Thus,

an increase in the valuation of the social security benefits, ceteris paribus, raises the equilibrium level of formal employment and the equilibrium wage differential between the informal and the formal sector.

To summarize, the Colombian social security reform of 1993 implemented the three previously mentioned changes simultaneously. In cases (i) and (ii) the higher contributions reduce the equilibrium level of formal employment, whereas in case (iii) the higher valuation of the benefits raises it. The final impact on the sectoral composition of employment depends on which of these effects dominates. If the effect of the higher valuations of the benefits dominates the one of the rise in contributions, then the level of formal employment increases. The opposite happens in the alternative case. In addition, the model predicts an increase in the equilibrium wage differential between the informal and the formal sector in cases (ii) and (iii), while it predicts a reduction in case (i). The final result will depend on which of these effects dominates. In Colombia, however, the social security reform increased the employer's contributions 3.5 times more than the employee's contributions.[8] Hence, I expect the impact of the higher employer's contributions to dominate. The actual magnitude of the effects is determined by the workers valuation of the benefits financed by these payroll taxes and the after-tax wage differential elasticity of supply and demand.

[8] See Table 1 and Figure 1

1.4 Data and Descriptive Statistics

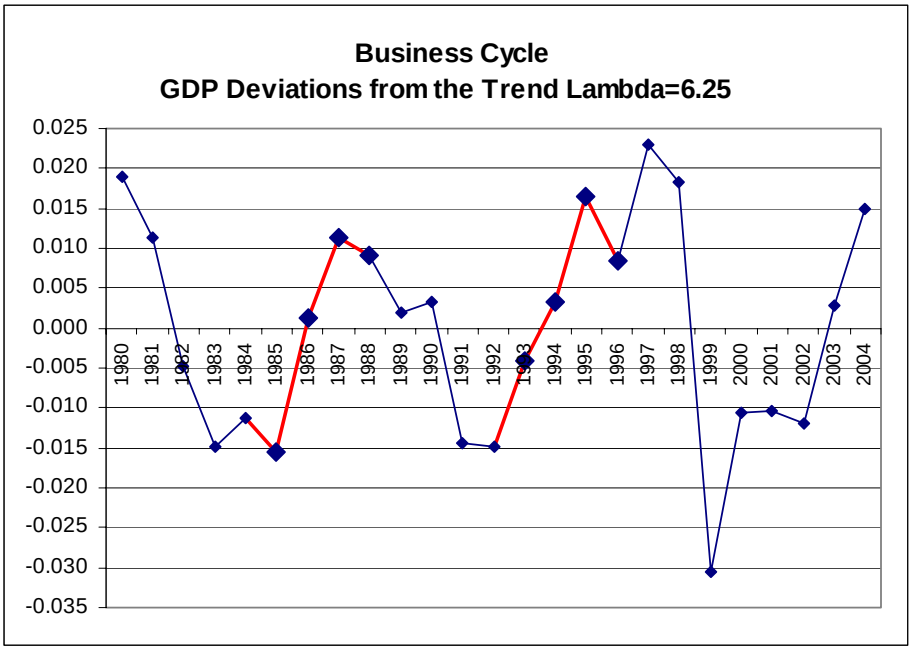
The data I use for the estimation are the June waves of the Colombian National Household Survey for the years 1984, 1986, 1988, 1992, 1994, and 1996. The year 1990 is not included in the sample due to data availability and because it is a period of deep structural transformations that affected the labor market. [9] The survey is a cross section administered in the ten most important metropolitan areas in the country. As seen in Figure 2, the year 1992 is a year of economic contraction while 1994 and 1996 are years of economic expansion that precede the big recession the country experienced in 1999. Hence, it is important to control for the business cycle in order identify the effect of the 1993 social security reform on the sectoral composition of employment. To do so, I compare sectoral employment probabilities during the reform period with an earlier period that is similar in terms of the cycle. The corresponding control period comprises the years 1984, 1986 and 1988.[10]

I use the June waves because every two years they include a special module on informality that has information on whether the individual is affiliated with the social security system through his/her job. I make use of the availability of health social security benefits through the job, the individual's employment status, and her occupation to sort workers into four employment sectors. I classify agents in the wage-and-salary formal sector (WSF) if they work as a salaried or domestic service worker and have access to social security benefits through their jobs. I categorize agents in the wage-and-

[9] These changes include the approval of a new constitution, key reforms to the labor market, a major trade reform, and the liberalization in direct foreign investment.
[10] I estimated the business cycle using the Hodrick-Prescott (1997) filter with lambda=6.25.

salary informal (WSI) if they have a salaried job that does not provide health care social security benefits. I label workers as informal self-employed (SLF) if they are entrepreneurs, own account or unpaid family workers and do not have health social security benefits. Finally, the unemployed and the agents who do not participate in the market are grouped together in the non-market participation sector (NMP).

Figure 2



Source: Estimated by the author applying the Hodrick-Prescott (1997) filter to GDP data from the DANE - Banco de la República, Colombia

I employ only the availability of health care benefits because the question regarding the affiliation to the pension plan only appears after 1996. These two measures are highly correlated, however. Before the reform the affiliations to health care and pensions plans perfectly coincide since the public Social Security Institute managed both of them. Nevertheless, the 1993 reform introduced separate insurance administrators for each part

of the system altering this match. In 1996, 56% of the workers had access to health care benefits while only 47% had access to a pension plan. The higher coverage of the health care system is explained by the fact that the law requires proof of membership to it in order to affiliate a worker to the pension plan, but not the other way around.

In my estimation sample I only consider working age population. That is, women between 18 and 55 years of age and men between 18 and 60 years of age, for an average of 45,000 observations per year. In the theoretical model previously described I argue that the effect of the social security reform varies according to the workers valuation of the benefits. Although I do not observe this valuation directly, I believe that the family structure of the agent is a good proxy for it. Consequently, in addition to the two gender categories that comprise all the data in my sample, I define four different family structure categories per gender group according to the agent's headship, parenthood and marital status. These divisions are: married without young children, married with young children, single head-of-household, and single dependant.[11] The previous categories contain 72 and 84 percent of the female and male population in my sample, correspondingly.

Table 2 shows the distribution of workers across employment sectors by gender and family structure group for each year in the sample. The fraction of all females that belongs to the formal sector is 27% in 1992, proportion that increases to 31% in 1996. The share of informal-salaried and self-employed workers in 1992 is 24%, equally split between the two sectors. Nonetheless, this fraction decreases to 20% after the reform. It

[11] I consider children younger than 6 years of age as young children.

is interesting to note that the proportion of females in the non-market participation sector stays roughly constant at 49% during the reform period.

Table 2
Distribution of Agents Across Employment Sectors by Year and Family Structure Group

			WSF		WSI		SLF		NMP	
Females		Obs	Mean	S.e.	Mean	S.e.	Mean	S.e.	Mean	S.e.
All	1992	23679	27%	0.3%	12%	0.2%	12%	0.2%	49%	0.3%
	1994	24037	29%	0.3%	11%	0.2%	12%	0.2%	48%	0.3%
	1996	23927	31%	0.3%	10%	0.2%	10%	0.2%	49%	0.3%
Married	1992	6429	23%	0.5%	8%	0.3%	16%	0.5%	54%	0.6%
No	1994	6587	24%	0.5%	7%	0.3%	15%	0.4%	54%	0.6%
Children	1996	6663	27%	0.5%	6%	0.3%	12%	0.4%	55%	0.6%
Married	1992	5249	19%	0.5%	8%	0.4%	13%	0.5%	60%	0.7%
with	1994	5193	20%	0.6%	7%	0.3%	12%	0.4%	61%	0.7%
Children	1996	4931	23%	0.6%	6%	0.3%	10%	0.4%	61%	0.7%
Single	1992	503	54%	2.2%	15%	1.6%	15%	1.6%	16%	1.6%
Head	1994	640	53%	2.0%	14%	1.4%	15%	1.4%	18%	1.5%
	1996	684	54%	1.9%	15%	1.4%	13%	1.3%	18%	1.5%
Single	1992	4868	32%	0.7%	12%	0.5%	6%	0.3%	50%	0.7%
Dependant	1994	4937	36%	0.7%	11%	0.5%	5%	0.3%	47%	0.7%
	1996	4954	36%	0.7%	10%	0.4%	5%	0.3%	49%	0.7%
Males										
All	1992	20705	43%	0.3%	19%	0.3%	23%	0.3%	15%	0.3%
	1994	21123	44%	0.3%	18%	0.3%	23%	0.3%	15%	0.2%
	1996	21204	45%	0.3%	16%	0.3%	20%	0.3%	18%	0.3%
Married	1992	6138	50%	0.6%	13%	0.4%	29%	0.6%	8%	0.3%
No	1994	6316	49%	0.6%	13%	0.4%	30%	0.6%	7%	0.3%
Children	1996	6410	52%	0.6%	11%	0.4%	26%	0.5%	11%	0.4%
Married	1992	5233	50%	0.7%	19%	0.5%	27%	0.6%	4%	0.3%
with	1994	5168	50%	0.7%	19%	0.5%	28%	0.6%	3%	0.2%
Children	1996	4914	52%	0.7%	18%	0.5%	25%	0.6%	6%	0.3%
Single	1992	566	47%	2.1%	18%	1.6%	26%	1.8%	10%	1.2%
Head	1994	623	48%	2.0%	16%	1.5%	26%	1.8%	10%	1.2%
	1996	606	53%	2.0%	15%	1.4%	23%	1.7%	10%	1.2%
Single	1992	5468	32%	0.6%	23%	0.6%	12%	0.4%	33%	0.6%
Dependant	1994	5594	35%	0.6%	19%	0.5%	12%	0.4%	33%	0.6%
	1996	5598	34%	0.6%	18%	0.5%	11%	0.4%	37%	0.6%

WSF= Formal; WSI= Informal; SLF= Self employment; NMP= Non-market Participation

Although the share of male workers who participate in the market is much bigger, the change in the sectoral composition of employment, as a whole, is similar to that of females. In 1992, 43% of male agents belong to the formal sector, fraction that increases to 45% in 1996. On the other hand, the proportion of male workers in the WSI sector decreases from 19% in 1992 to 16% in 1996, and the corresponding share in the SLF sector drops from 22% in 1992 to 20% in 1996. Finally, males' non market participation increases from 15% in 1992 to 18% in 1996, mostly due to higher unemployment.

The patterns of how the sectoral composition of employment varies for males and females, in the aggregate, also hold for most family structure groups. Table 2 shows that in 1992 married women, especially those with children, are the demographic groups with the highest fraction of non-market participants and the lowest proportion of salaried formal and informal workers. After the reform the proportion of formal workers increases by 4 percentage points, whereas the fraction of salaried informal and self-employed workers decreases by 2 and 3 percentage points, respectively. Single head-of-household women stand out as the group with the highest proportion of market participants among women. Nevertheless, after the reform the proportion of self-employed decreases by 2 percentage points, coupled to an increase of the same magnitude in non-market participation and no change in the fraction of salaried formal and informal workers. Finally, for single dependent women formality increases by 4 percentage points between 1992 and 1996, while employment in the three remaining sectors decreases by 1 percentage point each.

Regarding males, Table 2 shows that married men, with and without children, have the highest proportion of formal and self-employed workers, each with approximately 50% and 28% respectively employed in these two sectors in 1992. After the reform; however, formality and non-market participation increase by 2 percentage points each, and salaried informality and self employment decrease by the same amount. Single head-of-household men experience a 6 percentage point increase in formal employment after the reform, the highest change overall, coupled to a 3 percentage point reduction in both salaried informality and self employment and no change in the proportion of non-market participants. Finally, single dependent males experience a 2 percentage point increase in formality, but also a 4 percentage point increase in non-market participation, mostly compensated by a 5 percentage point reduction in salaried informality.

1.5 Estimation Strategy and Results

My goal in this chapter is to identify the effect of the 1993 Colombian social security reform on the employment sector choice of workers and evaluate how it varies according to their valuation of the benefits. Although I cannot measure this valuation directly, I believe that the gender, headship, parenthood, and marital status of the worker are good proxies for this valuation. I expect women to have a higher valuation of social security benefits than men given their higher degree of risk aversion. I expect single head-of-household workers to have the highest valuation of both pension and health care benefits.

I anticipate this because they are the most risk averse group of them all[12], under the new health care system they are able to cover their dependants, and as heads-of-household are less likely to be beneficiaries of someone else's insurance. The group that should come second in terms of their valuation of the benefits is married workers with children, followed closely by married workers without children. I predict married workers should have a lower valuation of the benefits than single head-of-household workers because they are less risk averse[13], and they are more likely to rely on family systems as a form of insurance. I expect childless couples to have a lower valuation of the benefits than those with children since they have fewer dependants to cover. Finally, I anticipate single dependant workers to have the lowest valuation of both pension and heath care benefits, given that they can be a beneficiary of someone else's insurance, are younger, and are less risk averse than the other demographic groups[14].

My estimation strategy consists on categorizing agents by their family structure type and evaluating for each category how the probability of belonging to a given employment sector changes from before to during and after the reform. As previously mentioned, however, the year 1992 is a year of economic contraction while 1994 and 1996 are years of economic expansion that precede the big recession the country experienced in 1999. The previous literature on informality in Colombia has found that the formal sector exhibits a pro-cyclical behavior expanding during periods of economic growth (Florez 2002). Hence, it is important to control for the business cycle in order to single out the

[12] Jianakoplos and Bernasek (1998), Deleire & Levy (2004)
[13] Ibid
[14] Ibid

effect of the reform. To do so, I include in my estimation sample an earlier period that is similar in terms of the cycle but did not experience a reform that altered the sectoral composition of employment. As seen in figure 2, this period corresponds to the years 1984, 1986 and 1988. The year 1990 is not included in the sample due to data availability and because it is a period of deep structural transformations that affected the labor market. For this reason the years prior to 1990 are included only to control for the business cycle, but not as reference periods to measure the effect of the reform.

The following Multinomial Logit model of the probability that a worker belongs to any of the four employment sectors is estimated separately for ten demographic categories defined by the gender and family structure of the agent:[15]

$$\mathrm{P}[e_i = \xi \mid X_i, d_i] = \Lambda[\beta_0 + \beta_1' X_i + \beta_2 d_i + \beta_3 (d_i \times X_i) + \beta_4 R_i + \beta_5 Y_i] \qquad (8)$$

Where $\xi \in (WSF, WSI, SLF, NMP)$, X_i is a set of individual specific covariates that includes: marital status, headship status, age and its square, total number of people in the household, the proportion of employed and unemployed in the household, number of kids under age 6, and a set of dummy variables that control for education, whether the person is studying, migration status, and geographical location. The business cycle variables are the deviation of real GDP from trend, d_i, and its interactions with the city and skill level variables, $(d_i \times X_i)$. In addition, R_i is a dummy variable that equals 1 during the 1992-

[15] I use Eicker White Standard Errors to Account for common random effects at the city sector level.

1996 period and zero otherwise and aims to control for the structural changes that occurred in Colombia in 1990.

Finally, Y_i is a vector of year dummies for 1994 and 1996 whose coefficients measure the effect of the social security reform on the agents' employment sector choice. The coefficient for the 1994 dummy measures mostly the effect of the pension reorganization, while the coefficient for the 1996 dummy represents the aggregate effect of the pension and health care reforms. It is important to point out, however, that the coefficient for the 1994 dummy identifies the effect of the pension reform only if the health care reorganization that followed was not anticipated by the agents. If the workers anticipated the future changes in the health care system and reacted to them before they were actually implemented, I can only identify the cumulative effect of both reforms and its timing during the reorganization period.

The Table 1.a in the Appendix shows the Wald test of significance of the coefficients across equations for each family structure group considered. The upper panel shows the individual significance test and the bottom panel presents the joint test of significance for groups of variables. For females as a whole all the coefficients are statistically significant at a five percent level, whereas in the regression that includes all males in the sample the coefficient of the dummy variable that controls for the 1990 reform is not statistically significant. The same coefficient is not statistically significant for single dependent women and married men with young children. Across all the family structure groups

considered the variables that control for age, education, migration, expenditure unit and the business cycle are jointly statistically significant.

The multinomial logit model makes the assumption of Independence of Irrelevant Alternatives (IIA), which implies that adding another alternative or changing the characteristics of alternatives does not affect the relative odds between any two alternatives. In some circumstances this hypothesis might be too strong, thus I check it by implementing the Hausman and McFadden (1984) test. As shown in Table 2.a in the Appendix, the test fails to reject the IIA assumption across all gender and family structure groups; except when considering all females in the sample and the formal sector alternative is omitted from their choice set. These results are consistent with the IIA assumption. Furthermore, a Wald test for combining outcome categories rejects the hypothesis that any of the employment sector alternatives can be combined.[16]

Table 3 characterizes the cumulative impact of the social security reform on employment sector choice for each of the reference groups considered. In addition, Figure 3 shows the separate effects of the pension and health care reforms on females' sectoral choice, and Figure 4 shows the corresponding results for males. Recall that the figures shown for the 1996-1992 period quantify the cumulative effect of both reforms, that the figures for the 1994-1992 period mostly measure the impact of the pension reform, and that the difference between these two give the estimates for the 1996-1994 period that mainly represent the impact of the health care reorganization.

[16] The results of the Wald test for combining outcome categories are available on request.

Table 3

Effect of Social Security Contributions on Employment Sector Choice

Females		1992	1994	1994-1992	95% CI		1996	1996-1992	95% CI	
All	Pr(y=WSF|x):	27.8%	30.5%	**2.7%**	1.6%	3.8%	33.5%	**5.7%**	3.9%	7.6%
	Pr(y=WSI|x):	4.6%	3.9%	**-0.6%**	-1.0%	-0.3%	3.6%	**-0.9%**	-1.3%	-0.6%
	Pr(y=SLF|x):	10.0%	9.1%	**-0.9%**	-1.4%	-0.4%	7.7%	**-2.3%**	-2.8%	-1.9%
	Pr(y=NMP|x):	57.6%	56.5%	**-1.1%**	-2.4%	0.1%	55.2%	**-2.5%**	-3.9%	-1.0%
Married	Pr(y=WSF|x):	30.0%	32.4%	**2.4%**	0.1%	4.7%	36.8%	**6.8%**	4.3%	9.3%
No	Pr(y=WSI|x):	4.2%	3.2%	**-1.0%**	-1.4%	-0.5%	2.8%	**-1.5%**	-1.8%	-1.1%
Children	Pr(y=SLF|x):	11.1%	10.8%	**-0.3%**	-1.6%	1.0%	8.8%	**-2.3%**	-2.9%	-1.8%
	Pr(y=NMP|x):	54.7%	53.5%	**-1.2%**	-3.4%	1.1%	51.7%	**-3.0%**	-5.4%	-0.6%
Married	Pr(y=WSF|x):	16.9%	17.5%	**0.6%**	-1.9%	3.0%	23.3%	**6.4%**	3.2%	9.7%
Children	Pr(y=WSI|x):	3.5%	2.2%	**-1.3%**	-1.7%	-1.0%	2.0%	**-1.5%**	-2.0%	-1.0%
	Pr(y=SLF|x):	6.8%	5.7%	**-1.1%**	-2.0%	-0.3%	5.2%	**-1.7%**	-2.4%	-1.0%
	Pr(y=NMP|x):	72.8%	74.7%	**1.9%**	-1.3%	5.0%	69.6%	**-3.3%**	-7.2%	0.6%
Single	Pr(y=WSF|x):	79.9%	85.7%	**5.8%**	3.9%	7.8%	86.4%	**6.5%**	3.8%	9.3%
Head	Pr(y=WSI|x):	9.0%	5.9%	**-3.1%**	-5.3%	-0.9%	6.3%	**-2.7%**	-5.4%	0.1%
	Pr(y=SLF|x):	8.4%	6.0%	**-2.3%**	-4.2%	-0.4%	5.0%	**-3.4%**	-5.1%	-1.7%
	Pr(y=NMP|x):	2.7%	2.3%	**-0.4%**	-1.1%	0.3%	2.2%	**-0.5%**	-1.2%	0.3%
Single	Pr(y=WSF|x):	42.4%	47.1%	**4.8%**	1.2%	8.3%	48.3%	**5.9%**	2.2%	9.6%
Dependant	Pr(y=WSI|x):	12.9%	11.7%	**-1.1%**	-3.5%	1.3%	10.9%	**-2.0%**	-4.8%	0.9%
	Pr(y=SLF|x):	4.1%	3.0%	**-1.1%**	-1.5%	-0.7%	2.7%	**-1.4%**	-1.8%	-1.0%
	Pr(y=NMP|x):	40.7%	38.1%	**-2.6%**	-6.2%	1.1%	38.2%	**-2.5%**	-5.8%	0.8%
Males										
All	Pr(y=WSF|x):	64.6%	65.6%	**1.0%**	-2.1%	4.1%	67.7%	**3.1%**	1.6%	4.6%
	Pr(y=WSI|x):	12.4%	10.4%	**-2.0%**	-3.3%	-0.6%	9.7%	**-2.6%**	-3.6%	-1.6%
	Pr(y=SLF|x):	21.5%	22.6%	**1.1%**	-0.9%	3.0%	20.8%	**-0.7%**	-2.5%	1.1%
	Pr(y=NMP|x):	1.6%	1.4%	**-0.1%**	-0.2%	0.0%	1.8%	**0.2%**	0.0%	0.4%
Married	Pr(y=WSF|x):	64.8%	63.7%	**-1.1%**	-5.4%	3.2%	67.2%	**2.4%**	-2.0%	6.7%
No	Pr(y=WSI|x):	6.6%	6.0%	**-0.7%**	-1.9%	0.6%	4.9%	**-1.8%**	-2.2%	-1.3%
Children	Pr(y=SLF|x):	25.5%	27.5%	**2.0%**	-1.2%	5.1%	24.4%	**-1.1%**	-4.6%	2.3%
	Pr(y=NMP|x):	3.1%	2.8%	**-0.2%**	-0.5%	0.1%	3.6%	**0.5%**	-0.6%	1.6%
Married	Pr(y=WSF|x):	64.4%	65.8%	**1.4%**	-0.5%	3.3%	68.2%	**3.8%**	1.3%	6.3%
Children	Pr(y=WSI|x):	12.2%	10.6%	**-1.7%**	-2.9%	-0.5%	10.2%	**-2.1%**	-3.5%	-0.7%
	Pr(y=SLF|x):	22.9%	23.2%	**0.4%**	-0.8%	1.6%	21.0%	**-1.8%**	-3.7%	0.1%
	Pr(y=NMP|x):	0.5%	0.4%	**-0.1%**	-0.2%	0.0%	0.6%	**0.1%**	-0.1%	0.3%
Single	Pr(y=WSF|x):	56.7%	56.9%	**0.3%**	-7.4%	7.9%	59.5%	**2.8%**	-1.2%	6.8%
Head	Pr(y=WSI|x):	11.2%	8.2%	**-3.1%**	-4.5%	-1.7%	6.9%	**-4.4%**	-6.8%	-1.9%
	Pr(y=SLF|x):	30.9%	33.9%	**3.0%**	-4.7%	10.8%	32.8%	**1.9%**	-3.2%	6.9%
	Pr(y=NMP|x):	1.2%	1.0%	**-0.2%**	-1.2%	0.7%	0.8%	**-0.4%**	-1.1%	0.3%
Single	Pr(y=WSF|x):	49.4%	53.0%	**3.6%**	-1.5%	8.7%	51.5%	**2.0%**	-2.1%	6.1%
Dependant	Pr(y=WSI|x):	19.1%	15.7%	**-3.4%**	-6.2%	-0.6%	15.4%	**-3.7%**	-6.0%	-1.4%
	Pr(y=SLF|x):	10.8%	10.9%	**0.1%**	-2.3%	2.5%	10.4%	**-0.4%**	-2.0%	1.1%
	Pr(y=NMP|x):	20.7%	20.4%	**-0.3%**	-1.4%	0.8%	22.8%	**2.1%**	0.3%	3.8%

Confidence intervals by delta method

WSF= Formal; WSI= Informal; SLF= Self employment; NMP= Non-market Participation

When considering all women in the sample, Table 3 shows that the reform generates a 6 percentage point increase in formality, a 2.5 percentage point reduction in the probability of both non-market participation and self employment, and a mere 1 percentage point decline in salaried informality. Regarding males, Table 3 shows that the reform increases males' formal employment probability by 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment by 0.7 percentage points, and has an insignificant effect on non-market participation.

Analyzing these results within the framework of the equalizing differences model of employment choice introduced in section 1.3, I conclude that the overall effect of the higher valuation of benefits dominates the effect of the augmented contributions. Furthermore, the lager positive effect on formality observed for women than for men reflects a greater valuation of social security benefits by females and their higher degree of risk aversion. This last fact is documented in a number of financial studies that confirm that women are more risk averse than men, even after controlling for the effects of other individual characteristics.[17] In addition, there is evidence that suggests that women tend towards lesser risk taking in labor markets than men, and are paid a higher compensating wage differential for accepting a given job-injury risk.[18]

Another possible source of the greater effect of the pension reform on female wages is the seemingly preferential treatment they receive. Women might have a higher valuation of the benefits received through the pension system due to their lower

[17] See Bajtelsmit and Bernasek (1996) for a review of the literature on gender differences in risk taking that pays particular attention to risk taking and investing for retirement.
[18] Hersch (1998), Jianakoplos and Bernasek (1998), Deleire and Levy (2004)

retirement age and longer life expectancy.[19] It is important to clarify, however, that this may possibly be only the product of a poor understanding of how their pension benefits are computed. As Uribe (2002) points out, a factor rarely know by the workers is that due to their lower wages and years contributing to the system, women will be penalized in the individual capitalization system where the benefits at the time of retirement are a function of the savings made and the life expectancy of the worker.

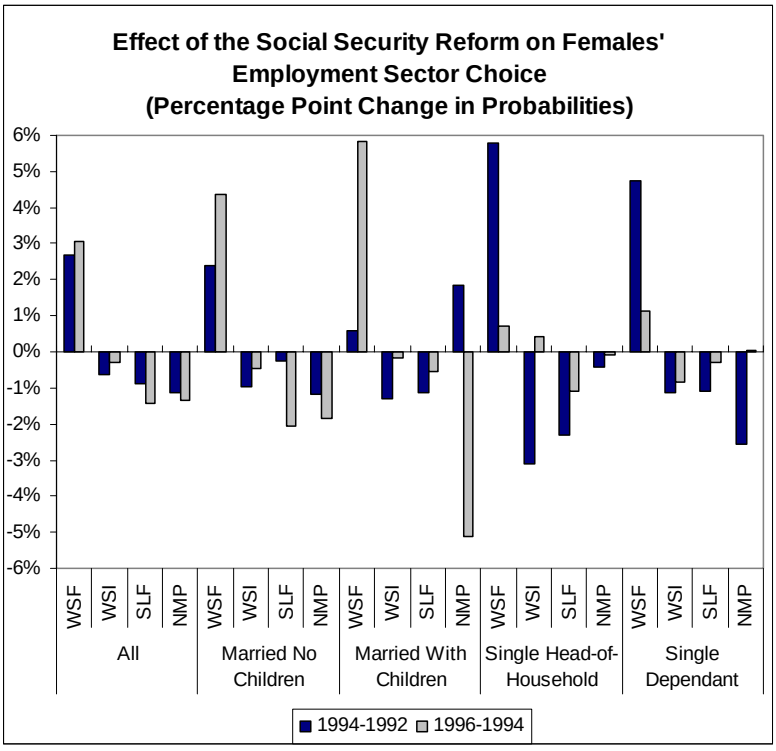
The effect of the reform also differs according to the family structure group considered. Table 3 and Figure 3 show that for married women, with and without children, the impact of the health care reform is much bigger than that of the pension reform. For example, almost all of the 6.4 percentage point increase in formality for married women with children is explained by the health care reform. On the other hand, for single head-of-household and single dependent females the effect of the pension reform is much bigger than that of the health care reform. For single females, regardless of the headship status, the pension reform increases the probability of formal employment by about 5 percentage points, whereas the health care reorganization increases formality by only 1 percentage point. These results indicate that married women value more the health care than the pension benefits, while the opposite occurs for single women.

Figure 3 and Table 3 show that married women, with and without children, are the family structure groups that experience the largest effects among women. They illustrate that the 6.8 percentage point increase in formality for married women without children

[19] The estimated life expectancy in the country is 69 years for men and 75 for women, while their retirement age is 60 and 55 years for men and women, respectively.

comes with a reduction of about 2 percentage points in both self employment and non-market participation during the second part of the reform, whereas for married women with children a similar increase in formality is coupled to a sharp 5 percentage point reduction in non-market participation. Moreover, the 5.8 percentage point increase in formal employment experienced by single head-of-household women after the pension reform is tied to a 3 and 2.5 percentage point reduction in salaried informality and self employment, respectively. The smoother increase in formality for single dependent women during the same period is joined by a 2.5 percentage point reduction in non-market participation.

Figure 3

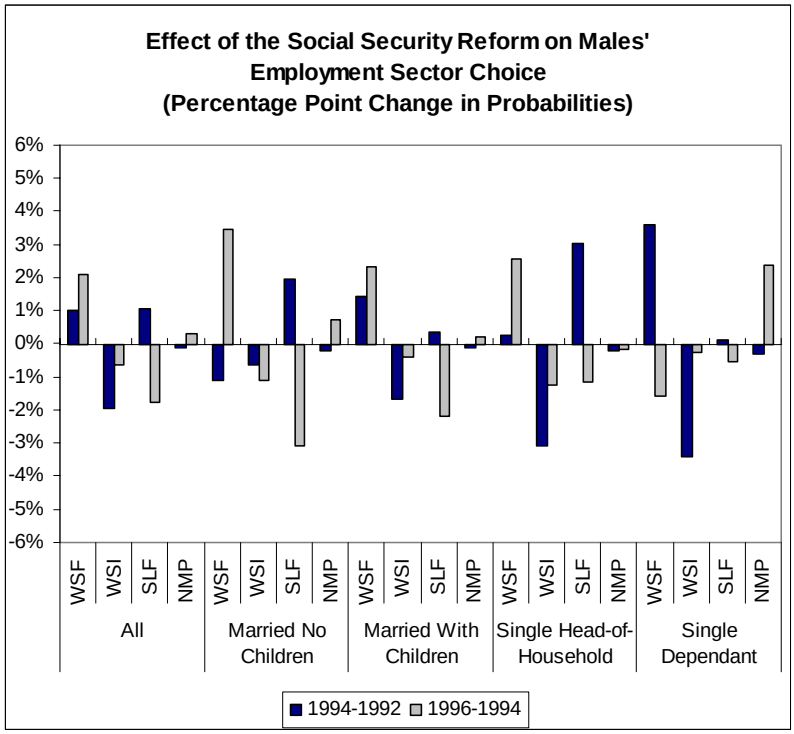


WSF= Formal; WSI= Informal; SLF= Self employment; NMP= Non-market Participation

Similarly to what happens with women, Table 3 and Figure 4 show that the pension and health care reorganizations have a differential impact on the employment sector choice of males, depending on their marital and headship status. Nevertheless, it is important to point out that for all family structure groups considered, the magnitude of the effect of the reform on the probability of male formal employment is at least 2 percentage points lower than that of females. This result highlights the lower valuation of social security benefits that men have relative to women.

Figure 4 shows that the health care reform increases the probability of formal employment by 3 percentage points on average for all family structure groups, except for single male dependants. For this category formality decreases by 1.6 percentage points between 1994 and 1996, indicating that during this period the increase in the contributions is not offset by an increase in the valuation of the benefits. The effect of the health care reform on formality is lower for married men with children than for those without children, which signifies a relatively higher valuation of these benefits by the later demographic group. The effect of the pension reform, however, has the opposite pattern. For married men without children it reduces the probability of formal employment by 1 percentage point while for those with children it raises it by 1.5 percentage points. Interestingly, single dependent males is the group of men that experiences the largest positive effect of the pension reform with an increase in the probability of formal employment of 3.6 percentage points.

Figure 4



WSF= Formal; WSI= Informal; SLF= Self employment; NMP= Non-market Participation

There is also a marked differential effect of the pension and health care reforms on the informality of males. Both reforms reduce salaried informality for married and single men, regardless of their headship or parenthood status, but the effect of the pension reform is larger than that of the health care reorganization. This difference is more pronounced for single dependent men. For this group salaried informality decreases during the first part of the reform by 3.4 percentage points, whereas during the second part the effect is not statistically significant. In addition, the pension reorganization increases the probability of self employment for all family sector groups considered. The impact is particularly strong on single head-of-household and married males without

children, increasing self employment by 3 and 2 percentage points, correspondingly. The health care modification counterbalances these effects, however, reducing self employment by 1 and 3 percentage points, respectively.

As a final point, Figure 4 shows that the health care reform increases the non-market participation of single dependants, while it has an insignificant effect on the non-market participation of the other family structure groups. Furthermore, the pension reform does not have a significative impact on the market participation of any demographic categories considered.

To summarize, these results indicate that, although the pension and health care reforms both generate an increase in formality in the aggregate, they have a differential impact on the sectoral composition of employment depending on the gender and family structure group considered. The overall effect of the reform is bigger for females than it is for males. Furthermore, the pension reorganization has a relative higher positive impact than the health care reform on the probability of formal employment for single workers, while the opposite occurs for married workers, regardless of the gender group considered. Among women, I find that for married women the health care reform is the basis for a transition from non-market participation and self employment into formality, especially for those with young children. On the other hand, for single head-of-household and single dependent women the pension reform is the major cause of the shift from salaried informality, self employment, and non-market participation into formality. Regarding males, the pension reform shifts employment from salaried informality into self

employment for single head-of-household men, and from salaried informality into formality for single dependants. Conversely, the health care reform reallocates married men from self employment into formality, and shifts single head-of household males from salary informality and self employment into formality.

As previously mentioned, the differential effect of the social security reform across family structure groups reflects their different degrees of risk aversion. This statement is supported by two recent studies on risk aversion across demographic groups. A study by Jianakoplos and Bernasek (1998) that estimates relative risk aversion by gender and marital status in financial investment markets, finds that single men and married couples are relatively less risk averse than single women, which in the context of this chapter implies a lower valuation of the pension benefits by single men and married couples and therefore a lower positive effect of the pension reform on formality. In addition, a study by DeLeire and Levy (2004) that examines worker sorting across occupations in response to risk of dead on the job finds that single moms and single dads are more averse to risk than married men and women with children and people without children. Finally, concurring with my results, they find that the effect of parenthood for those who are married is much larger for women than for men.

The patterns of how these effects vary across family structure groups are also consistent with the theoretical link between the magnitude of the impacts and the workers' valuation of the social security benefits. The health reform replaced the existing affiliation system that covered only the worker, with one that covers also the spouse and

children or the parents of the worker. Consequently, after the reform, single dependent workers are able to get access to health care benefits through their parents, which attenuates their valuation of these benefits. For single dependent females this smoothes the increase in formality, whereas for single dependent males it generates a reduction in formal employment. On the other hand, married and single head-of-household women, especially those with young children, are now able to cover their dependants, which strengthen their valuation of health care benefits. Consequently, these are the demographic groups where the probability of formal employment increases the most.

The previous findings on employment are theoretically consistent with the equalizing differences model of employment choice presented in Section 1.3, corresponding to the case where the effect of the higher valuation of social security benefits and the tighter link between benefits and contributions dominate the impact of the augmented contributions.

1.6 Conclusions

This chapter analyzed the relationship between social security taxes and the choice of employment sector in Colombia. I departed from previous literature by examining the effect of a benefit-linked payroll tax, differentiating between the separate impacts of pension and health care contributions, investigating how the effects vary according to the workers valuation of the benefits, and considering the heterogeneity of the informal sector in developing countries. I estimated a multinomial logit model of the probability

that a worker belongs to any of the following employment sectors: formal, wage-and-salaried informal, self employment, and non-market participation. I used as a natural experiment the Colombian social security reform of 1993, which transformed the institutional framework for pension funds and health care provisions and provides a large exogenous variation that allows me to identify the effect of the contributions.

After controlling for the business cycle I find that, in the aggregate, a 10 percentage point increase in social security contributions accompanied by an improvement in the quality and quantity of the benefits, generates a 6 percentage point increase in the formal employment of females, a 2.5 percentage point reduction in both self employment and non-market participation, and a 1 percentage point fall in salaried informality. On the other hand, the reform increases males' formal employment probability by only 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment by 0.7 percentage points, and has an insignificant effect on males' non-market participation.

These results disagree with the early time series and cross-sectional literature on payroll taxes and entrepreneurship that frequently conclude that higher income or general payroll tax rates generate higher levels of self employment because of the higher incentives for tax evasion. My contrasting results highlight the important role played by the link between benefits and contributions and the worker valuation of the benefits. Overall, my results are theoretically consistent with a model of employment sector choice, corresponding to the case where the effect of the higher valuation of social

security benefits dominates the impact of the augmented contributions. Furthermore, the patterns of how these estimated effects vary across family structure groups are consistent with the theoretical link between the magnitude of the effects and the agent's valuation of the social security benefits.

However, the theoretical model presented in Section 1.3 cannot help me to interpret what is happening within the informal sector. Consequently, an extension to the model to take into account four economic sectors and a binding minimum wage in the wage-and-salary formal sector, would improve the understanding of the effects of payroll taxes on employment sector choice in an economy that is in partial compliance with the social security regulations.

Chapter 2: The Effect of Social Security Contributions on Wages

2.1 Introduction

The theory of compensating differentials predicts that, under full valuation of the benefits, workers who receive more generous fringe benefits are paid a lower wage than comparable workers who receive fewer fringe benefits, all else being equal. Consequently, an increase in a benefit-linked payroll tax will result in lower wages but no change in the level of employment. In this chapter, I estimate the fraction of social security contributions that is transferred to workers in the form of lower wages, and how it varies according to the workers valuation of the benefits, using as a natural experiment the Colombian social security reform of 1993.

The end of the 1980's and early 1990's was a period of deep structural transformations in Latin America. These reforms were part of efforts to liberalize economies and increase the participation of the market in the production and allocation of goods and services, and were the product of the collapse most economies experienced during the 1980's due to their mounting fiscal and monetary imbalances.[20] In Colombia the main reforms during this period included the approval of a new constitution, key reforms to the labor market, a major trade reform, and liberalization in direct foreign investment.

Three years after these reforms were put in place Colombia implemented a social security reorganization that transformed the institutional framework for pension funds

[20] Heckman and Pages (2003).

and health care provision (Law 100 of December 1993). Regarding the health care regime, the social security reform replaced the existing discretionary affiliation system that covered only the worker, by a mandatory one that features a stricter prepayment system and covers also the spouse and children, or the parents of the worker. On the subject of pensions, the reform introduced a fully funded social security system giving workers the choice between the traditional benefit defined in the existing pay-as-you-go system, and the new one of individual capitalization of public funds. The greater benefits also brought along an increase in employees and employers' pension and health care contributions, raising the payroll tax rate by over 10 percentage points.

There is a large amount of work on the effects of the trade and labor reforms on the Colombian labor market. The literature on the social security reform, however, has focused on its overall economic effects, with only one study dealing with its labor market implications. Kugler and Kugler (2003) analyze the effect of the reform on wages and employment using a panel of manufacturing plants in Colombia for the 1982-1996 period. Their estimates indicate that a 10 percentage point increase in payroll taxes reduces wages between 1.4% and 2.3%, and employment between 4% and 5%. Nevertheless, their firm-level data only provide information on the average wage and tax rate, do not allow controlling for individual demographic characteristics, and only measure the aggregate effect on the manufacturing sector.

The differences-in-differences estimation approach I follow in this chapter uses the partial compliance with the regulation and the gradual rise in social security contributions

generated by the Colombian reform to estimate the effect of the contributions on wages and how it varies according to the workers valuation of the benefits. Although I cannot measure this valuation directly, I believe that marital and headship status and the presence of young children in the household are good proxies for this valuation. Consequently, I estimate the effects of the social security reform by categorizing agents according to their family structure type and comparing, within each category, the hourly wage of those with social security benefits to the hourly wage of those without benefits, and evaluating how they changed from before to after the reform. The findings of this chapter have important policy implications for they reveal who would pay for an expansion in social security benefits, or an extension in its coverage.

My results show that a 10 percentage point increase in payroll taxes, accompanied by an improvement in the quality and quantity of the benefits, reduce the hourly wages of female workers with access to social security benefits by 5% relative to the hourly wages of those without access to the benefits. On the other hand, I find that the hourly earnings of male workers in the wage-and-salary formal sector increase by 2% relative to the earnings of those in the wage-and-salary informal sector. Among females, the impact is greater for married mothers and single head-of-household females, whereas it is not significantly different from zero for single dependent women and married women without young children. Among men, the effect is not statistically significant for any of the family structure groups considered. The patterns of how these estimated effects vary

across demographic groups are consistent with the theoretical link between the magnitude of the effects and the workers' valuation of the social security benefits.

This chapter is structured by presenting in the next section a review of the empirical and theoretical literature on the effects of social security contributions on wages. Section 2.3 lays out the empirical identification approach. Section 2.4 presents the data and descriptive statistics. Section 2.5 presents the results and section 2.6 summarizes and concludes.

2.2 Literature on the Effects of Social Security Contributions on Wages

Theoretically, social security contributions are considered a benefit-linked payroll tax because of the connection between the taxes paid by or on behalf of each worker and that individual's expected benefits. Hence, with the presence of tax-benefits linkages workers receive a higher compensation, and the contributions are analogous to a price paid for a privately supplied commodity (Summers 1989). A general payroll tax, on the other hand, has no linkage to benefits for the individual taxpayer and therefore carries efficiency costs. The benefit linkages of social security contributions depend on the extent to which workers perceive that they are getting them back as benefits and how much the individual values those benefits. This depends in turn on the quality of the services offered by the entities financed by the tax. If they are perceived as good, employees will consider the contributions as a deferred compensation or insurance program, and will accept a reduction in the net wage with no employment effects. If they are perceived as bad, the

contributions will be considered as a pure tax with the corresponding effects on employment. Additionally, as mentioned by Gruber (1997), a key determinant of tax-benefits linkages is the extent to which the benefits are provided to both contributors and non-contributors, in the sense that if equal benefits are extended to the non-contributors for free, or at a highly subsidized rate, it will mitigate any tax benefits linkages for workers. In most real-world social security systems, the link between contributions and benefits is ambiguous because the benefits financed by payroll taxes are not exactly accrued by employees. Hence, contributions to social security programs often contain an element of pure taxation in concert with elements of deferred compensation or insurance program.

Gruber (1997) develops the standard model to analyze the wage effects of social security contributions. He uses a partial equilibrium model of the labor market with benefit-linked payroll taxes levied on both employers and employees. In that model an increase in the employer's contributions drives wages down, while an increase in the employees' contributions drives wages up. The final effect on wages will be the net result of these two forces, which depends on the elasticities of demand and supply, and the extent to which employees discount their payroll tax payments and value employers' payments relative to cash income. Gruber (1998) points out three scenarios under which increased employer's social security contributions are fully transferred on to lower wages. One possibility is a very tight tax-benefit linkage where workers also value the benefits at their full cost. In that case contributions would be like a price paid for a

privately supplied commodity. Another case is a perfectly inelastic labor supply, and a third scenario is a perfectly elastic labor demand. If labor demand is not perfectly elastic, or labor supply is not perfectly inelastic, and there exist a divergence between taxes paid and benefits accrued, then a pure tax effect arises and only part of the higher payroll taxes will be transferred to lower wages. In such a case, the greater the elasticity of demand comparatively to the elasticity of supply, and the higher the valuation of the benefits received in exchange, the greater the effect of social security contributions on wages.

Although a great number of the empirical literature on the effect of social security reforms on wages has focused on Latin America, given that it is a region that experienced a series of large and exogenous social security reforms during the last two decades, [21] there is also a great deal of related literature that focuses on the labor market effects of mandated employer-provided benefits in the United States.

One of the first empirical studies on the labor market effects of payroll taxation is Hamermesh (1979). Using data from the PSID he examines the degree to which workers' earnings are affected by the share of the tax paid by employers. He finds that 15-35% of any increase in the payroll tax is shifted by employers on to labor and that this occurs mostly within the first year after a tax increase becomes effective. Later on, however, Gruber and Krueger (1991) using Current Population Survey (CPS) data find that higher employers' cost of workers compensation insurance are largely shifted to employees in

[21] In general, these reforms changed the rate of payroll taxes and affected the relationship between social security contributions and benefits, which had substantial effects on the region's labor market. See Heckman and Pages (2003) for a detailed survey of the literature on the cost of regulation in Latin America, which includes the cost of social security contributions.

the form of lower wages and do not have a statistically significant effect on employment. Subsequently, Gruber (1994) uses a differences-in-differences approach to analyze the effect of state and federal laws that mandated comprehensive coverage for childbirth in private health insurance policies; regulation that exogenously increased the cost of employing women of childbearing age and their husbands. The mandated tax differed across states at a point in time and within states over time, which allow him to control for time-series trends, fixed state differences in wages, and state specific shocks that are correlated with the passage of the laws. He uses data from the CPS and finds that all the costs generated by the law are shifted to the wages of the target group with no effect on the net labor supply of that group.

Afterward, Gruber (1997) studies the wage effect of the Chilean social security reform of 1981 that exogenously reduced average payroll tax rates by 25%, and strengthened its benefit linkage. He uses data from a census of manufacturing firms to model the change in wages at a given plant as a function of the calculated average tax rate. He further controls for measurement error in the tax and wage bills, and finds that the reduction in the payroll tax burden of Chilean firms increased wages by the same amount, indicating full transfer of taxes to wages with little effect on the level of employment. Given these results he concludes that there is generally little efficiency cost from financing employee benefits through payroll taxation.

Contrary to what happened in Chile, in Colombia the payroll tax reform raised the contributions by 10.5 percentage points. It is interesting to compare the incidence of the

reforms in both countries given that, if wages are flexible upward but not downward, there could be full shifting to wages as a result of a reduction in payroll taxes but not as a result of an increase. Kugler and Kugler (2003) address this issue using a panel of manufacturing plants in the formal sector in Colombia for the period 1982-1996. They follow the estimation approach of Gruber (1997) by constructing tax rates for each plant and controlling for measurement error in the tax and wage bills. Their estimates indicate that a 10 percentage points increase in payroll taxes reduces formal wages between 1.4% and 2.3% and formal employment between 4% and 5%. They explain this partial transfer to wages as a result of the weak bond between benefits and contributions and downward rigidities in wages due to the presence of a binding minimum wage. Kugler and Kugler (2003) also find less shifting and more unemployment effect for production than for non-production workers, which they explained by the fact that the minimum wage is more likely to be binding for the former group of workers.

It is important to point out that Gruber (1997) and Kugler and Kugler (2003) firm-level data only provide information on the average wage and tax rate, do not allow controlling for individual demographic characteristics, and only measure the aggregate effect of the reform on the manufacturing sector. By using the Colombian National Household Survey data set, I consider a broad set of economic activities and occupations, obtain the wage rate for each worker, and control for individual demographic characteristics.

In particular, the chapter at hand contributes to the literature by estimating how the effect of social security contributions on wages varies according to the workers valuation of the benefits. Although I cannot measure this valuation directly, I believe that marital and headship status and the presence of young children in the household are good proxies for this valuation.[22] The differences-in-differences approach I follow in this chapter also utilizes the gradual increase in the contributions generated by the reform and the fact that informal employment, or employment that does not comply with the social security regulations, has traditionally been a large component of total employment in Colombia. Consequently, I analyze the effect of the social security reform by categorizing agents according to their family structure type and evaluating for each category how the wage differential between formal and informal sectors varies from before to during and after the reform.

2.3 Empirical Specification

Closely related to the literature on the effect of social security reforms on the labor market, there exists a considerable amount work dealing with the estimation of the impact of health insurance on wages. Currie and Madrian (1999) provide a good survey of this literature and point out that one of the biggest concerns facing this area of research is an issue of identification, for it is difficult to distinguish between the effects of health

[22] DeLeire and Levy (2004) use a similar strategy in their study of working sorting across occupations in response to the risk of death on the job.

insurance and the effects of other variables that are correlated with both health insurance and wages.

Suppose that $SS_i = 1$ is an indicator of whether or not person i receives social security benefits through his/her job. In addition, denote $W_i(1)$ the wage they have if they work in the formal sector and $W_i(0)$ if they work in the informal sector. Holding everything else constant, the difference $W_i(1) - W_i(0)$ is the causal effect of belonging to the formal sector on their wage. A common assumption in the literature is that the fact that person *i* belongs to the formal sector does not affect any other person. Under this scenario we can estimate the effect of having social security benefits on wages using the following linear model:

$$Log(W_i) = \beta' X_i + \alpha' SS_i + \xi_{1i} \qquad (9)$$

Equation (9) is a Mincerian wage equation that regresses the log of real hourly wages against a vector of traditional determinants of real wages, X. If X fully captures all the factors that affect wages other than the social security benefits, then $\hat{\alpha}$ will be an unbiased estimate of the net effect of firm and workers' social security contributions on wages. The coefficient can be interpreted as a compensating wage differential for social security. If the employees value the benefits obtained through employer provided social security at their full cost, the workers are going to perceive the contributions as a payment for the received services and will accept a reduction in their wage compensation, and therefore $\hat{\alpha}$ will be negative. If there is only a partial valuation of the benefits, the

magnitude and sign of the coefficient will depend on the elasticities of supply and demand, the employee's valuation of the benefits, and the statutory burden of the tax.[23]

Unfortunately, the econometrician rarely observes all the non-social security related factors that affect wages. In this case the error term ξ_{1i} in equation (9) contains all these omitted variables. If social security availability is correlated with these unobserved characteristics, then the bias of $\hat{\alpha}$ in the OLS estimation of equation (9) is given by:

$$E(\hat{\alpha}) - \alpha = \theta \frac{\text{cov}(SS_i \delta_i)}{\text{var}(SS_i)} \qquad (10)$$

Where δ_i is the vector of unobserved individual characteristics such as ability or productivity, and θ is the effect of this unobserved characteristic on wages.

If the effect of the unobserved characteristic on wages is positive ($\theta > 0$), and workers with high level of ability/productivity look for higher compensation both in wages and social security benefits ($\text{cov}(SS_i \delta_i) > 0$), then $\hat{\alpha}$ will be positively biased, masking any tradeoff that the employees are willing to make to get access to social security benefits. Because of this problem, most of the empirical literature has found that the estimated wage differential for health insurance tends to be positive, contrary to what the theory of compensating differential predicts. [24]

Nevertheless, if this bias is constant for all years in the sample, one can use a differences-in-differences estimation approach to difference out the omitted variable bias.

[23] The reduce-form estimation approach does not allow sorting out either the structural sources of the wage change, or distinguishing the effects of employers and employees' social security contributions.
[24] See Currie and Madrian (1999), Olson (2002), MaCurdy and Rapoport (2003)

[25] That is, by comparing the effect of social security contributions on wages from before to after the Colombian reform; I can eliminate the bias due to unobserved heterogeneity and leave only the effect of the increase in social security contributions on wages. This procedure can be summarized in the following reduced form wage equation:

$$\begin{aligned} Log(W_i) = \beta_0^{'} X_i + \beta_1^{'} d_i + \beta_2^{'}(d_i \times X_i) + \beta_3^{'} S_i + \beta_4^{'} R_i + \beta_5^{'} Y_i \\ + \beta_6^{'}(S_i \times d_i) + \beta_7^{'}(S_i \times R_i) + \beta_8^{'}(S_i \times Y_i) + \upsilon_i \end{aligned} \quad (11)$$

Where W_i is the real hourly wage, X_i is a vector of traditional determinants of real wages comprising: education, experience, experience square, tenure, marital status, headship status, an indicator of whether the person is studying, the presence of kids under age 6, geographical location, migration status, occupation, industry, kind of contract, firm's size, and place of work. The business cycle variables are the deviation of real GDP from its trend, d_i, and its interactions with the city, industry, occupation, tenure and skill level variables, $(d_i \times X_i)$. In addition, S_i is a dummy equal to 1 if worker i receives social security benefits through his/her job, Y_i is a vector of year dummies for 1994 and 1996, and R_i is a dummy variable that equals 1 during the 1992-1996 period and zero otherwise and aims to control for the structural changes that occurred in Colombia in 1990. I also include the interaction $(S_i \times d_i)$ to control for sector specific cyclical effects, and the interaction $(S_i \times R_i)$ to control for sector specific effects of the 1990 reforms.

---

[25] This implies that the product of θ and $\frac{\text{cov}(SS_i \delta_i)}{\text{var}(SS_i)}$ is constant over time.

The coefficients of interest are given by the interactions of the social security dummy with the year fixed effects, $(S_i \times Y_i)$, which capture the effect of the social security reform on wages. The coefficient for the 1994 interaction measures mostly the effect of the pension reorganization, while the coefficient for the 1996 interaction represents the aggregate effect of the pension and health care reforms. It is important to point out, however, that the coefficient for the 1994 interaction identifies the effect of the pension reform only if the health care reorganization that followed was not anticipated by the agents. If the agents anticipated the future changes in the health care system and reacted to them before they were actually implemented, then I can only identify the cumulative effect of both reforms and its timing during the reorganization period.

This identification approach is similar to the one used by Kugler (2000) in her study of the incidence of job security regulations on the Colombian labor market. She uses the temporal change in the legislation introduced by the labor market reform of 1990, together with the regulation's coverage disparity, to control for self-selection and the difference in shocks across groups. However, she points out that this methodology only allows her to identify a lower bound for her parameter of interest.

Finally, to investigate how the valuation of the benefits affects the estimates of the impact of the reform, I define four family structure categories per gender group that I expect to vary on this valuation. These categories are: married agents with and without children, single head-of-household workers, and single dependants. I expect single head-of-household workers to have the highest valuation of both pension and health care

benefits. I anticipate this because they are the most risk averse group of them all[26], under the new health care system they are able to cover their dependants, and as heads-of-household are less likely to be beneficiaries of someone else's insurance. The group that should come second in terms of their valuation of the benefits is married workers with children, followed closely by married workers without children. I predict married workers should have a lower valuation of the benefits than single head-of-household workers because they are less risk averse[27], and they are more likely to rely on family systems as a form of insurance. I expect childless couples to have a lower valuation of the benefits than those with children since they have fewer dependants to cover. Finally, I anticipate single dependant workers to have the lowest valuation of both pension and heath care benefits, given that they can be a beneficiary of someone else's insurance, are younger, and are less risk averse than the other demographic groups[28].

2.4 Data and Descriptive Statistics

The data I use for the estimation are the June waves of the Colombian National Household Survey for the years 1984, 1986, 1988, 1992, 1994, and 1996. The year 1990 is not included in the sample due to data availability and because it is a period of deep structural transformations that affected the labor market.[29] The survey is a cross section administered in the ten most important metropolitan areas in the country. I use the June

[26] Jianakoplos and Bernasek (1998), Deleire & Levy (2004)
[27] Ibid
[28] Ibid
[29] These changes include the approval of a new constitution, key reforms to the labor market, a major trade reform, and the liberalization in direct foreign investment.

waves because every two years they include a special module on informality that has information on whether the individual receives social security benefits through his/her job. As seen in Figure 2, the year 1992 is a year of economic contraction while 1994 and 1996 are years of economic expansion that precede the big recession the country experienced in 1999.[30] Hence, it is important to control for the business cycle in order identify the effect of the 1993 social security reform on wages. To do so, I include in my estimation sample an earlier period that is similar in terms of the cycle but did not experience any reform that affected the labor market. The corresponding control period comprises the years 1984, 1986 and 1988.

I make use of the availability of health social security benefits through the job, the individual's employment status, and his/her occupation to sort workers into three employment sectors. I classify agents in the wage-and-salary formal sector (WSF) if they work as a salaried or domestic service worker and have access to social security benefits through their jobs, and I categorize agents in the wage-and-salary informal sector (WSI) if they have a salaried job that does not provide health care social security benefits. I use only the availability of health benefits to classify workers into sectors because the question regarding the affiliation to the pension system only appears in the survey after 1996. However, these two measures are highly correlated. Before the reform the affiliations to health and pensions perfectly coincide since the public Social Security Institute managed both of them. The 1993 reform introduced different private insurance

[30] I estimated the business cycle using the Hodrick-Prescott (1997) filter with lambda=6.25

administrators for the health and pension part of the system altering this match, however. In 1996 for example, 56% of the workers has access to health care benefits, while only 47% has access to pension benefits. The higher coverage the health social security has, relative to its pension counterpart, is explained by the fact that the law requires proof of affiliation to the health care regime in order to affiliate a worker to the pension part of the system, but not the other way around.

Previous studies of the informal sector in Colombia, that use a different characterization of the informal sector based on firm size, have found that more than 50% of the total working population belong to this sector, comprised mainly by the self-employed, unpaid family workers, domestic service, salaried workers employed in small firms, and micro enterprise owners. According to the official figures of the Colombian National Department of Statistics, in 1992 informal employment represented 54% of total urban employment, proportion that decreased to 52.3% in 1996.

In my estimation sample, however, I include only prime age salaried workers that are employed full-time in the private sector. I exclude self-employed workers because their earnings reports have large measurement errors given that they confound salary with the returns from capital investments and the earnings of unpaid family workers. I exclude government employees because they receive fringe benefits obtained in collective conventions of labor, and some of them, such as the military, the teachers, and the Colombian Oil Company's employees, have their own social security entities that are unaltered by the reform. In addition, I exclude female workers over 55 years of age and

male workers over 60 years of age in view of the fact that they are beyond the legal retirement age in Colombia. My final sample has on average 8.900 men and 5.500 women per year.

In this resulting sample, a higher fraction of the working population belongs to the formal sector, and this fraction increases after the reform. Table 4 shows that formal employment among females augmented from 60% in 1992 to 66% in 1996, while formality rose from 49% to 54% among male workers. Table 4 also shows that the increase in formality holds across almost all family structure groups considered.

The increase in salaried formality might be explained by the higher benefits and stronger tax-benefit linkages brought along by the reform, which increased the incentives to comply with the regulation for workers with high valuation of those benefits. Furthermore, the reform introduced special insurance promoter institutions whose main goal is to promote enrollment and hire the services of providers for the case of health, or promote enrollment and manage the funds collected for the case of pensions. An evidence of these factors is the rise in the proportion of workers enrolled in the pension system, which went from 23% in 1993 to 40% in 1996, with almost all the increase explained by new affiliations to the individual capitalization system managed by the private insurance promoter institutions.[31]

The differences-in-differences estimation approach basically compares the wage differential between the formal and the informal sectors from before to during and after

[31] Asofondos (2001)

the reform. Consequently, it is important to identify the job and demographic characteristics of these sectors and how they changed over time. Regarding the demographic characteristics, Table 5 shows that, in 1992, formal sector workers are on average older, with 31 years of age for females and 33 years of age for males, compared to salaried informal workers with average ages of 29 and 30 years for females and males, respectively. Although the average age increases for both employment sectors after the reform, the increase is higher in the formal sector, which widens the age gap.

Table 4
Distribution of Agents Across Employment Sectors
By Year and Family Structure Group

		Females						Males					
		1992		1994		1996		1992		1994		1996	
Structure	Sector	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.
All	WSF	60%	0.6%	63%	0.6%	66%	0.6%	49%	0.5%	51%	0.4%	54%	0.5%
	WSI	25%	0.5%	22%	0.5%	21%	0.5%	26%	0.4%	24%	0.4%	23%	0.4%
	SLF	14%	0.4%	15%	0.4%	13%	0.4%	25%	0.4%	26%	0.4%	23%	0.4%
Married No Children	WSF	58%	1.4%	60%	1.3%	65%	1.3%	50%	0.8%	49%	0.8%	55%	0.8%
	WSI	22%	1.1%	17%	1.0%	15%	0.9%	18%	0.6%	18%	0.6%	15%	0.6%
	SLF	21%	1.1%	23%	1.1%	20%	1.1%	32%	0.8%	33%	0.8%	30%	0.7%
Married With Children	WSF	58%	1.6%	63%	1.6%	67%	1.5%	49%	0.9%	49%	0.8%	53%	0.9%
	WSI	23%	1.4%	17%	1.2%	18%	1.2%	23%	0.7%	23%	0.7%	23%	0.7%
	SLF	20%	1.3%	20%	1.3%	15%	1.2%	28%	0.8%	29%	0.8%	25%	0.8%
Single Head	WSF	21%	2.6%	18%	2.1%	22%	2.3%	25%	2.4%	21%	2.1%	20%	2.1%
	WSI	67%	3.0%	69%	2.6%	66%	2.6%	48%	2.8%	53%	2.6%	56%	2.6%
	SLF	12%	2.1%	13%	1.9%	12%	1.8%	26%	2.4%	26%	2.3%	25%	2.3%
Single Dependant	WSF	72%	1.1%	74%	1.1%	75%	1.1%	52%	1.0%	56%	1.0%	56%	1.0%
	WSI	22%	1.1%	21%	1.0%	21%	1.0%	35%	0.9%	30%	0.9%	31%	0.9%
	SLF	6%	0.6%	6%	0.6%	4%	0.5%	13%	0.7%	15%	0.7%	13%	0.7%

WSF= Formal; WSI= Informal; SLF= Self employment

There is a positive relationship between the level of schooling and formality. As shown in Table 5, the formal sector is more skill intensive with 3 more years of schooling for females and 2 more years of education for males. It is important to mention, however,

that the skill level increases in all sectors after the reform, which maintains the skill gap constant for men, but narrows it for women. The differences in the average age and schooling attainment across employment sectors reproduce in differences in the average potential experience. Table 5 shows that males in the wage-and-salary formal sector have the highest potential experience with an average of 18.3 years, followed by salaried informal males and females with 17.6 years and 16.2 years of experience, correspondingly. The average experience across sectors does not change significatively after the reform. Only for females in the formal sector the potential experience increases by 1 year, which reduces the gap with the salaried informal sector. Finally, Table 5 shows that formal workers also have the highest tenure with an average of 2.6 years, while salaried informal workers have only an average of 2 years of tenure. These figures stay roughly constant over the period of study.

On the subject of job's characteristics, Table 5 shows that, before the reform, 90% of women and 77% of men in the formal sector worked in a fix place such as a factory or an office, while only 60% of the workers in the salaried-informal sector did. After the reform, however, the proportion of salaried informal women that work in a fixed place increases by 7 percentage points, while the corresponding fraction for women in the formal sector decreases 3 percentage points. Finally, firms in the formal sector are bigger with an average of 3.5 employees, one more than the firms in the wage-and-salary informal sector. As seen in Table 7, these numbers remained rather stable after the reform. The above figures reflect that most of the firms in the informal sector have to

restrict their size and location in order to avoid detection and maintain their informal status. In fact, 60% of the firms in the salaried-informal sector have 5 workers or less.

Table 5
Workers and Job Characteristics Across Sectors
Wage-and-Salary Workers

		Females						Males					
		1992		1994		1996		1992		1994		1996	
		mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.	mean	s.e.
Age	WSF	31.0	0.1	31.6	0.1	32.0	0.1	33.3	0.1	33.0	0.1	34.0	0.1
	WSI	29.3	0.2	29.6	0.2	29.7	0.2	30.6	0.2	30.9	0.2	30.9	0.2
Schooling	WSF	9.8	0.1	9.9	0.1	10.0	0.1	8.9	0.1	9.1	0.0	9.2	0.0
	WSI	7.1	0.1	7.5	0.1	7.7	0.1	7.0	0.1	7.0	0.1	7.2	0.1
Potential Experience	WSF	15.1	0.2	15.7	0.2	16.0	0.2	18.3	0.2	17.9	0.1	18.7	0.1
	WSI	16.2	0.2	16.1	0.3	16.0	0.3	17.6	0.2	17.9	0.2	17.7	0.2
Tenure	WSF	2.5	0.0	2.5	0.0	2.6	0.0	2.7	0.0	2.6	0.0	2.7	0.0
	WSI	1.9	0.0	1.9	0.0	2.0	0.0	2.1	0.0	2.1	0.0	2.1	0.0
Firm Size	WSF	3.5	0.0	3.4	0.0	3.4	0.0	3.5	0.0	3.5	0.0	3.4	0.0
	WSI	2.4	0.0	2.4	0.0	2.5	0.0	2.8	0.0	2.9	0.0	2.8	0.0
% Office/ Factory Work	WSF	0.90	0.01	0.88	0.01	0.87	0.01	0.77	0.01	0.77	0.01	0.73	0.01
	WSI	0.61	0.01	0.62	0.01	0.68	0.01	0.59	0.01	0.56	0.01	0.59	0.01

WSF=Wage-and-Salary Formal; WSI= Wage-and-Salary Informal.

Table 6 shows an initial examination of the relationship between earnings and social security benefits across family structure groups. The comparison is made taking into account not only monetary income, but also an alternative measure of earnings that includes non-pecuniary retributions such as food or housing. The results are similar for both measures; hence, I only report the first one. I find that, before the reform, the mean real hourly wage is on average 44% higher for female workers covered by the social security than for females in the non-compliant sector. Men in the formal sector, on the other hand, earn just 29% more than their counterparts in the wage-and-salary informal

sector. These earning gaps narrowed through time, especially for women where both gaps decreased by 10 percentage points.

Table 6
Wage Differential Across Family Structure Groups

		Females						Males					
		1992		1994		1996		1992		1994		1996	
Log (W)		mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
All	WSF	7.17	0.01	7.22	0.01	7.23	0.01	7.27	0.01	7.33	0.01	7.33	0.01
	WSI	6.72	0.01	6.82	0.01	6.89	0.01	6.99	0.01	7.06	0.01	7.06	0.01
	First Dif.	0.44	0.01	0.40	0.01	0.35	0.01	0.29	0.01	0.26	0.01	0.27	0.01
Married w/o Children	WSF	7.27	0.02	7.26	0.02	7.24	0.02	7.35	0.01	7.43	0.01	7.39	0.01
	WSI	6.86	0.03	6.88	0.03	6.98	0.03	7.08	0.02	7.13	0.02	7.14	0.02
	First Dif.	0.40	0.03	0.38	0.03	0.26	0.03	0.27	0.02	0.29	0.02	0.25	0.02
Married w/ Children	WSF	7.23	0.02	7.26	0.02	7.27	0.02	7.29	0.01	7.33	0.01	7.34	0.01
	WSI	6.76	0.03	6.88	0.03	6.98	0.04	7.01	0.02	7.12	0.02	7.11	0.02
	First Dif.	0.47	0.04	0.37	0.03	0.30	0.04	0.27	0.02	0.21	0.02	0.23	0.02
Single Head	WSF	7.28	0.04	7.30	0.04	7.25	0.04	7.31	0.04	7.33	0.04	7.40	0.04
	WSI	6.88	0.07	6.90	0.05	6.92	0.04	7.00	0.04	7.10	0.05	7.14	0.05
	First Dif.	0.40	0.08	0.39	0.06	0.34	0.05	0.31	0.06	0.23	0.06	0.26	0.06
Single Dependant	WSF	7.19	0.01	7.27	0.01	7.31	0.01	7.18	0.01	7.24	0.01	7.27	0.01
	WSI	6.82	0.02	6.94	0.02	6.97	0.02	6.89	0.01	6.97	0.01	7.01	0.01
	First Dif.	0.38	0.03	0.33	0.02	0.35	0.03	0.29	0.02	0.27	0.02	0.26	0.02

WSF=Wage-and-Salary Formal; WSI= Wage-and-Salary Informal.

The wage differential, although always positive, varies across family structure groups throughout the sample period. Married women with children are the group with the highest wage differential, followed by single head-of-household women, married women without children, and single dependent women, in that order. This sorting, however, is reversed among males, where single dependent men have some of the highest wage differential, while married men with children have the lowest gap of all groups.

As mentioned in section 2.3, the positive association between wages and social security benefits highlight the role of self-selection into sectors according to the unobserved productivity or ability of the worker. Workers with high demand for social security benefits also have high levels of ability/productivity that will influence their compensation, making the coefficient of the formal sector dummy in equation (9) positively biased, and masking any tradeoff that the employees are willing to make to get access to social security benefits.

2.5 Results of the Differences-in-differences Estimation.

Table 7 shows the OLS estimation of equation (11) for males and females, using Eicker White robust standard errors to account for common random effects at the sector level.[32] The differences-in-differences equation regresses the log of the hourly real wage on a constant, education, experience, experience square, tenure, marital status, headship status, indicators of whether the person is studying, the presence of kids under age 6, geographical location, migration status, industry, occupation, kind of contract, firm's size, place of work, the availability of social security benefits, a set of business cycle variables, a dummy for the post 1990 period, a vector of year dummies for 1994 and

[32] This regression was run including and excluding self-employed workers from the estimation sample. The estimated effect of the reform on the wage differential between the wage-and-salary formal and informal sectors is not affected by the sample selection rule. However, the estimated effect of the reform on the earnings differential between the wage-and-salary informal and the self employment sectors is suspiciously large. As mentioned earlier, the earnings reports of self-employed workers have large measurement errors given that they confound salary with the returns from capital investment and the earnings of unpaid family workers. Furthermore, self-employed workers have high incentives to misreport earnings for tax evasion purposes. For all these reasons I do not present the estimates for the self employment sector in the results that follow.

1996, and interactions of the social security dummy with the business cycle and post 1990 dummy that controls for sector specific effects of the business cycle and the 1990 reforms. Finally, the coefficients that measure the effect of the pension and health care reforms on wages are those of the interactions of the social security dummy with the 1994 and 1996 year dummies.

To illustrate the effect of including controls on the differences-in-differences estimation, I added them gradually to the regression equation. Column 1 in Table 7 includes no controls; column 2 controls for demographic characteristics; column 3 adds controls for occupation and industry fixed effects and so forth. Each cell contains the OLS coefficient and standard errors of the differences-in-differences estimation of the effect of social security contributions on wages. On each panel, the first two rows compare the wage gap between sectors for the years 1996 and 1994 to the corresponding difference in wages in 1992, and measure the net effect of the increment in social security contributions on the relative wages of formal sector workers. In addition, row 3 shows the effect of the 1990 reforms on the wage differential and row 4 shows the time invariant effect of social security contributions on wages. Finally, rows 5, 6, and 7 show the time series changes on wages and the effects of the 1990 reforms that are common to both sectors.

First of all, it is important to notice that contrary to the predictions of the compensating differential theory, the estimate of the time invariant effect of social security on wages in row 4 is positive for all specifications, confirming the existence of

an omitted variable bias. Note also that the bias declines with more detailed controls. Furthermore, note that gradually adding controls to equation (11) also reduces the differences-in-differences coefficients that measure the effect of the 1993 reform.

Table 7
Effect of Social Security of Wages
Difference in Difference Estimation

Females	1	2	3	4	5
WSF x Year96	**-0.100**	**-0.089**	**-0.072**	**-0.056**	**-0.046**
	0.000	0.002	0.005	0.005	0.008
WSF x Year94	**-0.047**	**-0.048**	**-0.042**	**-0.035**	**-0.027**
	0.000	0.002	0.002	0.002	0.003
WSF x Post 1990	**-0.124**	**-0.117**	**-0.103**	**-0.084**	**-0.092**
	0.000	0.010	0.009	0.007	0.004
WSF	**0.566**	**0.345**	**0.276**	**0.179**	**0.180**
	0.000	0.013	0.019	0.011	0.010
year94	**0.101**	**0.098**	**0.091**	**0.091**	**0.183**
	0.000	0.001	0.001	0.001	0.003
year96	**0.164**	**0.132**	**0.125**	**0.115**	**0.233**
	0.000	0.001	0.002	0.003	0.002
Post 1990	**0.102**	**0.012**	**0.014**	**0.009**	**-0.070**
	0.000	0.008	0.005	0.004	0.005
Males					
WSF x Year96	**-0.016**	**-0.011**	**-0.009**	**-0.001**	**0.024**
	0.000	0.001	0.001	0.004	0.007
WSF x Year94	**-0.025**	**-0.012**	**-0.009**	**-0.002**	**0.019**
	0.000	0.001	0.001	0.001	0.002
WSF x Post 1990	**0.004**	**-0.023**	**-0.027**	**-0.016**	**-0.030**
	0.000	0.000	0.001	0.002	0.002
WSF	**0.284**	**0.149**	**0.144**	**0.093**	**0.091**
	0.000	0.007	0.009	0.007	0.007
year94	**0.078**	**0.063**	**0.061**	**0.058**	**0.153**
	0.000	0.001	0.002	0.002	0.003
year96	**0.077**	**0.053**	**0.054**	**0.053**	**0.177**
	0.000	0.001	0.000	0.000	0.003
Post 1990	**-0.024**	**-0.052**	**-0.049**	**-0.055**	**-0.139**
	0.000	0.003	0.003	0.003	0.005
Controls					
Demographic Characteristics	N	Y	Y	Y	Y
Occupation & Industry	N	N	Y	Y	Y
Job Characteristics	N	N	N	Y	Y
Business Cycle	N	N	N	N	Y

WSF=Wage-and-Salary Formal dummy

Column 5 is the specification that contains the full set of controls, thus is the one that I discuss in more detail. In this regression the omitted category are unskilled married head-of-household workers who have a rural origin, are not attending school, and work without social security benefits in the service sector at firms that have only one employee and no fixed location.

The differences-in-differences coefficients as well as most of the coefficients for demographic, industry, city, occupation and firm characteristics are statistically different from zero and have the expected signs. Furthermore, the variables that control for cyclical effects at the sector, city, industry, occupation, tenure, and skill level also have jointly statistically significant coefficients.

As previously mentioned, during the first part of the reform the increase in payroll taxes is mainly due to pensions, whereas during the second part is mostly explained by higher health care contributions. However, I can isolate the effect of the pension reform only if the health care reorganization that followed was not anticipated by the agents. If the agents anticipated the future changes in the health care system and reacted to them before they were actually implemented, I can only identify the cumulative effect of both reforms and its timing during the reorganization period.

For females, the differences-in-differences coefficient for the year 1994 tell us that during the first part of the reform, a period of time during which social security contributions increase by 4.5 percentage points, there is a significant 2.7% drop in the wages of women in the formal sector of the economy relative to the wages of those in the

informal sector. By the year 1996 social security contributions rise by 10.5 percentage points and the corresponding differences-in-differences coefficient increases to 4.6%. This implies that, when considering all females in the sample, about half of the higher contributions are passed on to formal workers as lower wages. The effect of the social security reorganization is the opposite for males; however, with a 2.4% relative increase in the wages of men in the formal sector that occurs mostly during the first part of the reform. As mentioned before, the effect of the higher contributions on wages depends partly on the extent to which employees discount their payroll tax payments and value employers' payments relative to cash income. Consequently, a higher valuation of the benefits by females explains why employers are able to transfer half of the increased social security contributions to females and none to male workers.

Two possible explanations of the differential valuation of the benefits are that women are more risk averse than men and that they face a higher probability of being unemployed. The first factor is documented in a number of financial studies that confirm that women are more risk averse than men, even after controlling for the effects of other individual characteristics.[33] Furthermore, there is evidence that suggests that women tend towards lesser risk taking in labor markets than men, and are paid a higher compensating wage differential for accepting a given job-injury risk.[34] Regarding the second factor, during 1994-1996 period the unemployment rate for women is more than 5 percentage

[33] See Bajtelsmit and Bernasek (1996) for a review of the literature on gender differences in risk taking that pays particular attention to risk taking and investing for retirement.
[34] Hersch (1998), Jianakoplos and Bernasek (1998), Deleire and Levy (2004)

points higher than that for men, explained by an increase in the participation rate of women.[35]

A third possible source of the greater effect of the pension reform on female wages is the seemingly preferential treatment they receive. Women might have a higher valuation of the benefits received through the pension system due to their lower retirement age and longer life expectancy.[36] It is important to clarify, however, that this may possibly be only the product of a poor understanding of how their pension benefits are computed. As Uribe (2002) points out, a factor rarely known by the workers is that due to their lower wages and years contributing to the system, women will be penalized in the individual capitalization system where the benefits at the time of retirement are a function of the savings made and the life expectancy of the worker.

It is important to mention that the greater effect on female wages diverges from the findings of Mondino and Montoya (2000), who estimate hedonic wage functions using Argentinean PHS data for the 1990-1996 period. They find that male workers in the formal sector earn 8% less than their counterparts in the informal sector, while female workers sacrifice only 2.8% to get a job in the formal sector.[37] However, they fail to correct for unobserved heterogeneity, and their results depend heavily on their parametric assumption about the sample selectivity.

[35] According to the Colombian National Department of Statistics the average unemployment rate for the 1994-1996 period is 10%. The participation rate of women is still lower than that of men.
[36] The estimated life expectancy in the country is 69 years for men and 75 for women, while their retirement age is 60 and 55 years for men and women, respectively.
[37] The later coefficient is not statistically different from zero.

I also investigate how variations on the valuation of the benefits across family structure groups affect the estimates of the effect of the reform. Table 8 shows the results of the separate estimation of equation (11) for married workers with and without children, single head-of-household workers, and single dependants.

Married mothers and single head-of-household women are the demographic categories that experience the largest effects. For both of these groups the relative wages decrease by 10.5% between 1992 and 1996, which implies a full transfer of the higher contributions in the form of lower wages. For married mothers the effect occurs mostly during the first part of the reform, while for single head-of household women the effect is equally spread throughout the reform period. On the other hand, the relative wages of married women without children in the formal sector increase by 6% during the first part of the reform, but decrease by 5% during the second part, for a cumulative effect that is not significantly different form zero. Similarly, for single dependent females formal wages decrease by 5% between 1992 and 1994, but this effect is counterbalanced by a 2% increase between 1994 and 1996, for a cumulative effect that is not statically significant. Although of a smaller magnitude than women, married fathers and single head-of-household males are also the groups that experience the largest effects among men, with a 1.5% reduction in the wages of individuals in the formal sector relative to the wages of those in the informal sector. The effect, however, is not statistically significant for these or any of the other demographic groups of men.

Table 8

Difference-in-Diffeence Estimation of the Effect of Social Security on Wages

Females	All	Married w/o Children	Married w/ Children	Single Head	Single Dependant
WSF x Year96	**-0.046** **	**0.007**	**-0.105** **	**-0.105** *	**-0.029**
	0.008	0.004	0.016	0.030	0.017
WSF x Year94	**-0.027** **	**0.058** ***	**-0.096** **	**-0.048**	**-0.048** **
	0.003	0.005	0.013	0.040	0.008
WSF x Post 1990	**-0.092** ***	**-0.090** **	**-0.025**	**-0.005**	**-0.009**
	0.004	0.012	0.009	0.039	0.007
WSF	**0.180** ***	**0.146** **	**0.155** ***	**0.147** **	**0.122** ***
	0.010	0.021	0.007	0.021	0.010
WSF x GDP	**0.515**	**-3.354** ***	**2.163** **	**3.398**	**-0.183**
	0.381	0.308	0.226	1.390	0.592
year94	**0.183** ***	**0.060** ***	**0.221** ***	**0.258** **	**0.216** ***
	0.003	0.003	0.009	0.029	0.004
year96	**0.233** ***	**0.127** ***	**0.270** ***	**0.311** ***	**0.223** ***
	0.002	0.009	0.005	0.007	0.009
Post 1990	**-0.070** ***	**-0.069**	**-0.132** ***	**-0.162** **	**-0.143** ***
	0.005	0.007	0.009	0.021	0.004
Males					
WSF x Year96	**0.024** *	**0.001**	**-0.015**	**-0.013**	**0.001** **
	0.007	0.013	0.013	0.022	0.000
WSF x Year94	**0.019** **	**0.020**	**-0.012**	**0.009**	**0.016** **
	0.002	0.007	0.007	0.029	0.003
WSF x Post 1990	**-0.030** ***	**0.000**	**-0.003**	**-0.049**	**-0.020** **
	0.002	0.002	0.007	0.024	0.004
WSF	**0.091** ***	**0.092** ***	**0.084** ***	**0.062** **	**0.085** **
	0.007	0.005	0.007	0.013	0.015
WSF x GDP	**0.079**	**1.096** *	**0.850** *	**-2.331** **	**-0.925**
	0.078	0.329	0.264	0.281	0.346
year94	**0.153** ***	**0.152** ***	**0.208** ***	**0.181** **	**0.124** ***
	0.003	0.004	0.006	0.021	0.004
year96	**0.177** ***	**0.173** ***	**0.253** ***	**0.285** ***	**0.165** ***
	0.003	0.004	0.007	0.021	0.007
Post 1990	**-0.139** ***	**-0.164** ***	**-0.192** ***	**-0.148** **	**-0.113** ***
	0.005	0.002	0.007	0.021	0.006

WSF=Wage-and-Salary Formal dummy; * p<.1; ** p<.05; *** p<.01

I find similar patterns of the effects across family structure groups in the next chapter, where I examine the effect of social security contributions on hours worked. My results show that the social security reform reduces the weekly work of women in the formal

sector by 2 hours relative to the weekly hours worked by those in the informal sector of the economy. Similar to the wages results, the effect is particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effect is not statistically significant.

The effects of the social security reorganization on wages and hours worked are also connected to the effect of the reform on the employment sector choice of workers. In the previous chapter I find that, among females, the reform generates a 6 percentage point increase in the proportion formal workers, a 2.5 percentage point reduction in both self-employment and non-market participation, and a 1 percentage point fall in salaried informality. On the other hand, the reform increases males' formal employment probability by only 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment by 0.7 percentage points, and has an insignificant effect on males' non-market participation. Among females, my results show that for married women the reform is the basis for a transition from non-market participation and self employment into formality, especially for those with young children. Conversely, for single head-of-household and single dependent women the reform causes, in addition to the previous changes, a shift from salaried informality into formality.

As previously mentioned, the differential effect of the social security reform across family structure groups reflects their different degrees of risk aversion. This statement is supported by a study by Jianakoplos and Bernasek (1998). They use data from the U.S.

Federal Reserve's Survey of Consumer Finances (1989) to estimate relative risk aversion by gender in financial investment markets and find that single men and married couples are relatively less risk averse than single women. Therefore, I expect single women to have the highest valuation of the benefits of them all. Furthermore, a recent study by DeLeire and Levy (2004) that examines worker sorting across occupations in response to risk of dead on the job, finds that single moms and single dads are more averse to risk than married men and women with children and people without children. They also find, similar to what I find here, that the effect of parenthood for those who are married is much larger for women than for men.

The patterns of how these effects vary across family structure groups are also consistent with the theoretical link between the magnitude of the impacts and the workers' valuation of the social security benefits. The health reform replaced the existing affiliation system that covered only the worker, with one that covers also the spouse and children or the parents of the worker. Consequently, after the reform, single dependent workers are able to get access to health care benefits through their parents, which attenuate their valuation of these benefits. For single dependent females, this smoothes the increase in formality with the corresponding small reduction in the relative wages of formal sector workers. For single dependent males, it generates a reduction in formal employment and an associated increase in the relative wages of those in the compliant sector of the economy. On the other hand, married and single head-of-household women, especially those with young children, are now able to cover their dependants, which

strengthen their valuation of health care benefits. Consequently, they are the demographic groups that give up a higher fraction of their wages in order to get access to the social security benefits and, consequently, the groups where the probability of formal employment increases the most.

The previous findings on employment and wages are theoretically consistent with a theoretical model of employment sector choice presented in Section 1.3, corresponding to the case where the effect of the higher valuation of social security benefits and the tighter link between benefits and contributions dominate the impact of the augmented contributions.

2.6 Conclusions

In December of 1993 Colombia implemented a Social Security reorganization that transformed the institutional framework for pension funds and health care provision. The reform not only meant an increase in the contributions, but also an improvement in the quality of the benefits and an increase in the contribution-benefit linkage. The theory of compensating differentials predicts that, under full valuation of the benefits, an increase in a benefit-linked payroll tax will result in lower wages but no change in the level employment. In this chapter, I estimate the effect of social security contributions on wages and how it varies according to the workers valuation of the benefits. To do this, I employ a differences-in-differences approach that exploits the exogenous increase in the

contributions generated by the reform and the existence of a large fraction of employment in Colombia that does not comply with the social security regulation.

Given that social security availability is correlated with individual characteristics unobserved by the econometrician, such as ability or productivity, the OLS estimates of the effect of social security on wages are positively biased. Consequently, the literature has regularly found positive estimates of the effect of social security on wages, which contradict the predictions of the compensating differential theory. Nevertheless, if the correlation between the unobserved individual characteristics and the availability of social security benefits is constant for all the years in the sample, then, by comparing the effect of social security on wages for two different years one could eliminate the bias and leave only the effect of the augmented social security contributions on wages.

My results show that a 10.5 percentage point increase in payroll taxes, accompanied by an improvement in the quality and quantity of the benefits, reduce the hourly wages of female workers with access to social security benefits by 5% relative to the hourly wages of those without access to the benefits. On the other hand, the hourly earnings of male workers in the wage-and-salary formal sector increase by 2% relative to the earnings of those in the wage-and-salary informal sector. Among females, the impact is greater for married mothers and single head-of-household females, whereas it is not significantly different from zero for single dependent women and married women without young children. Among men, the effect is not statistically significant for any of the family structure groups considered. The patterns of how these estimated effects vary across

demographic groups are consistent with the theoretical link between the magnitude of the effects and the workers' valuation of the social security benefits. These findings have important policy implications for they reveal who would pay for an expansion in social security benefits, or an extension in its coverage.

An identification issue is present here, however. It could be the case that because of the tighter contribution-benefit linkage generated by the reform, more workers with high levels of ability and earnings look also for a higher compensation in social security benefits. If this happens, the unobserved ability bias increases with the reform and the differences-in-differences methodology used in this chapter only identifies the lower bound of the effect of social security on wages.

Moreover, the work of Kugler (2000) highlights two assumptions that lie behind the identification strategy used in the differences-in-differences estimation.[38] First, this procedure ignores the general equilibrium effects of the reform on the wages and composition of each sector, assuming that aggregate shocks affect both sectors equally. Second, it assumes that the composition of workers is constant over time. My findings in the previous chapter suggest that this is not the case. Therefore, it is important to explore this issue further, which is a topic of ongoing research.

[38] Marrufo (2001)

Chapter 3: Hours of Work Effect of Social Security Contributions.

3.1 Introduction

In this chapter I contribute to the understanding of the relationship between social security and the structure of employment, by empirically examining the effect of pension and health care social security contributions on hours worked. I concentrate on prime age workers and investigate how variations on the valuation of the benefits across family structure groups affect the estimates. I use Colombia as a case study because the country implemented a social security reform in 1993 that transformed the institutional framework for pension funds and health care provisions.

Regarding the health care regime, the reform replaced the existing discretionary affiliation system that covered only the worker, with a mandatory one that features a stricter prepayment system and also covers the spouse and children or the parents of the worker. On the subject of pensions, the reform introduced a fully funded social security system, giving workers the choice between the traditional benefit defined in the existing pay-as-you-go scheme, and the new one of individual capitalization of public funds. The greater benefits also brought along an increase in employees and employers' pension and health care contributions, raising the payroll tax rate by over 10 percentage points.[39]

To identify the effects of the contributions on the weekly hours of work, I follow a differences-in-differences estimation approach that uses the large exogenous change in the social security system and the fact that only a fraction of firms comply with the social

[39] For a more detailed description of the social security reform see Section 1.2.

security regulation. Specifically, I estimate the effects of the social security reform by categorizing agents according to their family structure type and comparing, within each category, the weekly hours worked by those with social security benefits to the hours worked by those without benefits, and evaluating how they changed from before to after the reform.

I find that the social security reform has a negative effect on the hours of work of women in the formal or compliant sector of the economy, reducing their average weekly work by 2 hours relative to the weekly hours worked by those in the informal sector of the economy. The effect is particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effect is not statistically significant. The effect on women is mostly explained by a reduction in the proportion of females that work part-time in the informal sector, who switched to full-time jobs in the formal sector in order to get access to social security benefits for themselves and their families. This change in the composition of employment sectors increases the average hours worked in the non-compliant sector but does not increase the average hours of work in the formal sector.

In the next section I present a brief discussion on the theoretical effects of social security contributions on hours of work. Section 3.3 presents the data and descriptive statistics. The empirical identification approach and the primary results are presented in section 3.4. Finally, section 3.5 provides a summary and concludes.

3.2 Literature on the Effects of Social Security Contributions on Hours Worked

Although there is not much literature specifically on the effects of social security contributions on hours worked, there are a lot of studies dealing with the estimation of the impact of employer-provided health insurance on labor supply. This research has concentrated for the most part on the effects on the elderly, lower income single mothers, and married couples in the United States. See Gruber (1998), Currie & Madrian (1999), and Gruber & Madrian (2002) for a critical examination of this literature. The latest review, done by Gruber & Madrian (2002), concludes that there is clear evidence that health insurance is a key determinant of retirement decisions, not a major determinant on the labor supply and welfare exit decision of low income mothers, and an important factor in the labor supply decisions of secondary earners.

To analyze the effect of these contributions on the Colombian labor market I consider a formal sector covered by social security regulations that coexists with an informal or unprotected sector that evades them, in an economy where wages are competitively determined. On the supply side, assume that the worker maximizes his utility U(C, L) that depends on market consumption goods (C) and Leisure (L), subject to an hourly wage rate (w) and total hours available (T). Define the pretax competitively determined wages in the formal and informal sectors as w_F and w_I, respectively; the payroll tax on formal sector firms as t_f; and the tax rate on formal sector workers as t_e, such that the total payroll tax equals to $T = t_e + t_f$.

Pensions and health care social security contributions are a benefit-linked payroll tax given that there is a connection between the taxes paid by or on behalf of each worker and that individual's expected benefits. Hence, with the presence of tax-benefits linkages workers receive a higher compensation, and the contributions are analogous to a price paid for a privately supplied commodity (Summers 1989). Therefore, access to health care and pension benefits constitute a lump-sum employment benefit that, if leisure is a normal good, may induce a negative income effect on desired hours of labor supply.

Nevertheless, Buchmueller and Valletta (1999), in their study of the effect of health insurance on married female labor supply in the United States, recognize that the effect may be more complex because there are only few part-time jobs that offer this kind of benefits. This is also true for the case of social security benefits in Colombia given that most formal sector firms do not hire part-time workers as salaried employees.[40] Consequently, most part-time employees work without employer-provided social security benefits while full-time employees can choose the employment sector at which his/her utility is maximized.

Panels A and B in Figure 5 show that individuals face the budget constraint a-b-c-d if they work in the informal sector of the economy, regardless of the number of hours, where the slope of the constraint is given by w_I, the pretax wage in the sector that does not comply with social security benefits. On the other hand, workers face the constraint a-b-c-f-e if they switch to the sector that provides social security benefits once they

[40] Formal sector firms hire most part-time workers as external contractors, who, as self-employees, must pay the entire social security contributions by themselves.

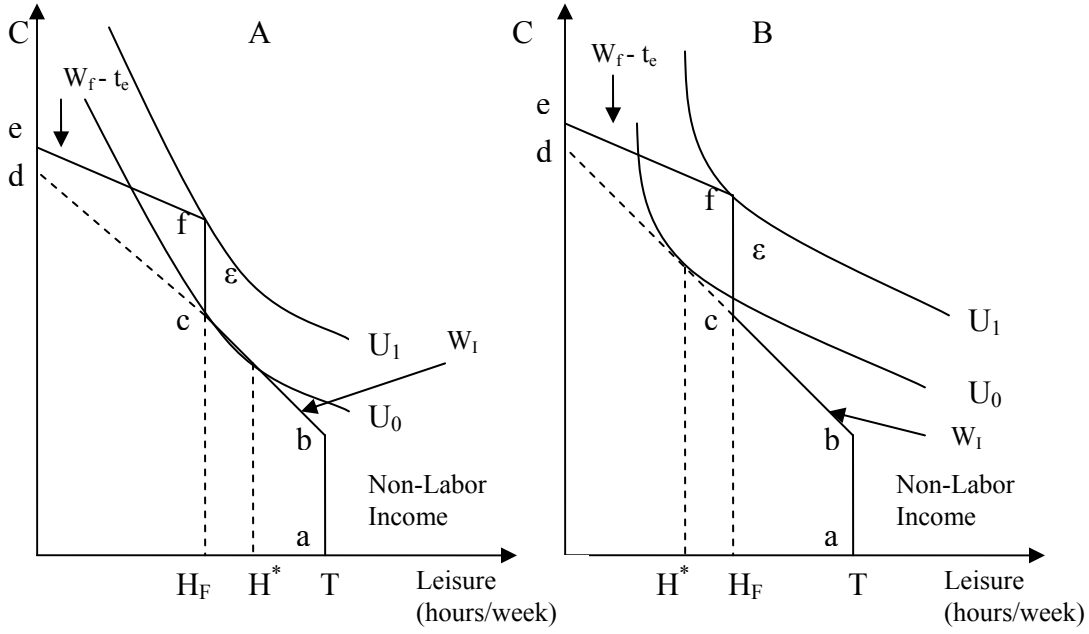
reached the minimum number of hours required to work in that sector, defined as H_F. The slope in the segment e-f is given by $w_F - t_e$, the after tax wage in the formal sector of the economy, while the slope in the segment b-c given by w_I. Similar to Buchmueller and Valletta (1999) for the case of health insurance, the second constraint has a jump on the workers budget constraint at the full-time threshold, where the height of this jump, defined as $\varepsilon_i \in (0, \bar{\varepsilon})$, depends on the extent to which employees value the access to social security benefits. If employee i values the access to social security benefits, then $\varepsilon_i \geq 0$. On the other hand, if worker i does not value the amenities received through social security, then $\varepsilon_i = 0$ and such a jump on the budget constraint does not exist.

Panel A in Figure 5 shows the case of employees that would otherwise be working part-time without access to employer-provided social security benefits, but switch to work full-time in the formal sector to get access to the social security benefits for themselves and their families. Panel B in Figure 5 shows a different scenario, where individuals that were working full-time in the informal sector before the reform switch to work full-time in the formal sector due to the improved quantity and quality of the social security benefits. A third scenario, not depicted in Figure 5, is the case of individuals that were working full-time in the formal sector of the economy before the reform and stayed in that sector after the reform. In all three cases, I expect the improved benefits brought by the Colombia social security reform of 1993 to increase the concentration of hours worked at or near the legal full-time threshold in the sector that provides those benefits. Furthermore, I anticipate that the effect would be particularly important among married

mothers and single head-of-household women given their high valuation of social security benefits, whereas for married women without children, single dependent women, and men in any family structure group the effect would not be significant.[41]

Figure 5

The Effect of Social Security Benefits on Hours of Work



On the demand side, the theoretical effect of health and pension benefits on hours of work in Colombia differs from the impact in the United States. Health insurance in the United States is a quasi-fixed cost that varies with the number of workers rather than the number of hours (Oi 1962). Cutler and Madrian (1998), in their study of labor market

[41] The differences in the valuation of the benefits across family structure groups will be explained in more detail in the next section.

responses to rising health insurance cost, develop a model that shows how an increase in the cost of health insurance, even if offset by wage reductions, will alter the trade off that firms face when allocating labor input between hours per worker and the numbers of employees hired. They state that "raising the fixed cost relative to marginal cost will lead firms to substitute hours for workers in allocating labor input". Empirically, they find that the rapid growth in health insurance in the 1980s led to an increase in hours of work among workers who received employer-provided health insurance, while workers without employer-provided health insurance actually experience a reduction in hours worked.

Colombian social security taxes are computed as a percentage of monthly earnings. Consequently, an increase in social security contributions affects the per hour cost of labor, while it does not affect the fixed cost of hiring someone. The standard theory on the demand of hours and workers states that a higher per hour cost of labor leads firms to substitute increased number of workers for fewer hours per employee. Furthermore, if both inputs are normal, the scale effect due to the higher marginal cost of production induces a reduction in both hours and workers. The final effect depends on the fraction of social security contributions that employers pass on to workers in the form of lower hourly wages, however.

In the second chapter I study the effect of social security contribution on wages and I find that a 10 percentage point increase in social security contributions, accompanied by an improvement in the quality and quantity of the benefits, reduces the hourly wages of female workers with access to social security benefits by 5% relative to

the wages of those without access to the benefits. On the other hand, I find that the hourly earnings of male workers in the wage-and-salary formal sector increase by 2% relative to the earnings of those in the wage-and-salary informal sector. Given that the higher social security contributions were not fully passed on to workers in the form of lower wages, I anticipate that the reform lead to a reduction in hours of work among workers who receive social security benefits, as compared to workers without social security benefits.

3.3 Data and Descriptive Statistics

The data I use for the estimation are the June waves of the Colombian National Household Survey for the years 1984, 1986, 1988, 1992, 1994, and 1996. The year 1990 is not included in the sample due to data availability and because it is a period of deep structural transformations that affected the labor market.[42] The survey is a cross section administered in the ten most important metropolitan areas in the country that, besides a complete set of demographic variables, has employment information including usual weekly hours worked. I use the June waves in particular because every two years they include a special module on informality that has information on whether the individual receives pension and health social security benefits through his/her job.

The year 1992 is a period of economic contraction while 1994 and 1996 are years of economic expansion that precede the big recession the country experienced in 1999. Hence, it is important to control for the business cycle in order to identify the effect of the

[42] These changes include the approval of a new constitution, key reforms to the labor market, a major trade reform, and the liberalization in direct foreign investment.

1993 social security reform on hours worked. To do so, I include in my estimation sample an earlier period that is similar in terms of the cycle but did not experience any reform that affected the labor market. The corresponding control period comprises the years 1984, 1986 and 1988.[43]

I use the availability of health social security benefits through the job, the individual's employment status, and her occupation to sort workers into two employment sectors. I classify agents in the wage-and-salary formal sector (WSF) if they work as a salaried or domestic service worker, regardless of the number of hours, and have access to social security benefits through their jobs, and I categorize agents in the wage-and-salary informal sector (WSI) if they have a salaried job that does not provide health care social security benefits. I use only the availability of health benefits to classify workers into sectors because the question regarding the affiliation to the pension system only appears after 1996.

In my estimation sample I include men aged 18-60 and women aged 18-55 who are salaried workers in the private sector. I exclude self-employed workers because their labor market decisions do not depend on the cost of benefits in the same way as do the hours worked of those employed by firms.[44] I exclude government employees because they receive fringe benefits obtained in collective conventions of labor, and some of them, such as the military, the teachers, and the Colombian Oil Company's employees, have their own social security entities that were unaltered by the reform. Finally, I

[43] See Figure 2 in Chapter 1.
[44] Cutler and Madrian (1998)

exclude female workers over 55 years of age and male workers over 60 years of age in view of the fact that they are beyond the legal retirement age in Colombia. My final sample has on average 9.300 men and 6.300 women per year.

To investigate how the valuation of the benefits affects the estimates of the impact of the reform, I define four family structure categories per gender group that I expect to vary on this valuation. These categories are: married individuals with and without children, single head-of-household workers, and single dependants regardless of their parenthood status. I expect single head-of-household workers to have the highest valuation of both pension and health care benefits because previous studies have found that they are the most risk averse family structure group among the categories I consider in this study,[45] under the new health care system they are able to cover their dependants, and as heads-of-household are less likely to be beneficiaries of someone else's insurance. The group that comes second in terms of their valuation of the benefits is married workers with children, followed closely by married workers without children. I predict married workers should have a lower valuation of the benefits than single head-of-household workers because they are less risk averse,[46] and they are more likely to rely on family systems as a form of insurance. I expect childless couples to have a lower valuation of the benefits than those with children since they have fewer dependants to cover. Finally, I

[45] Jianakoplos and Bernasek (1998) estimate relative risk aversion by gender in financial investment markets and find that single men and married couples are relatively less risk averse than single women. Furthermore, DeLeire and Levy (2004) examine worker sorting across occupations in response to risk of dead on the job, and find that single moms and single dads are more averse to risk than married men and women with children and people without children. They also find that the effect of parenthood for those who are married is much larger for women than for men.

[46] Ibid

anticipate single dependent workers to have the lowest valuation of both pension and heath care benefits, given that they can be a beneficiary of someone else's insurance, are younger, and are less risk averse than the other demographic groups I consider in this study.[47]

Table 9 shows the average weekly hours worked across employment sectors by gender and family structure group. Before the reform, female workers covered by the social security system work on average 46.6 hours per week, two hours more than females in the non-compliant sector. This gap narrowed through time, however. As Table 9 shows, the 1.3 hours increase in the amount of time worked by women in the informal sector was no compensated by the small increase in the weekly hours worked by those in the formal sector. Men in the compliant sector, on the other hand, work 51 hours per week throughout the sample period, slightly less than their counterparts in the wage-and-salary informal sector.

The hours of work differential also varies across family structure groups. Among women, married mothers are the group with the highest hours' differential between the formal and the informal sectors before the reform. However, they are also the group where the gap narrows the most, to a point that it becomes negative in 1996. On the other hand, married women without children are the only group where the gap increases after the reform, mostly due to a 1.5 hours increase in the weekly work of those with employer-provided social security benefits.

[47] Ibid

Table 9

Hours of Work per Week Across Family Structure Groups

		Females						Males					
		1992		1994		1996		1992		1994		1996	
	Sector	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
All	WSF	46.6	0.2	46.2	0.2	47.1	0.2	50.9	0.1	51.0	0.1	51.2	0.1
	WSI	44.6	0.4	44.1	0.4	45.9	0.4	50.9	0.2	51.8	0.2	51.3	0.2
	First Dif.	2.0	0.4	2.2	0.4	1.2	0.4	-0.1	0.3	-0.7	0.3	-0.1	0.3
Married w/o Children	WSF	46.6	0.3	46.2	0.3	48.1	0.3	52.4	0.3	52.3	0.3	52.1	0.2
	WSI	44.9	0.7	43.9	0.7	44.6	0.7	52.8	0.5	52.8	0.4	52.6	0.5
	First Dif.	1.7	0.8	2.3	0.8	3.5	0.8	-0.4	0.5	-0.5	0.5	-0.5	0.5
Married w/ Children	WSF	46.5	0.4	46.1	0.4	46.5	0.3	51.9	0.2	52.5	0.3	52.6	0.3
	WSI	43.7	0.8	42.5	0.9	47.2	0.9	53.6	0.4	53.9	0.4	53.1	0.4
	First Dif.	2.8	0.8	3.6	1.0	-0.7	1.0	-1.7	0.5	-1.5	0.5	-0.5	0.5
Single Head	WSF	48.5	0.7	47.8	0.6	49.1	0.6	50.3	0.9	50.6	0.7	51.6	0.8
	WSI	47.0	1.7	48.6	1.7	48.2	1.1	49.8	1.2	50.4	1.5	49.9	1.1
	First Dif.	1.5	1.8	-0.8	1.8	0.8	1.2	0.5	1.5	0.2	1.6	1.7	1.4
Single Dependant	WSF	46.4	0.2	46.0	0.2	46.2	0.2	47.7	0.3	47.9	0.2	48.3	0.2
	WSI	44.5	0.6	44.3	0.5	45.6	0.6	47.5	0.4	49.0	0.4	48.9	0.4
	First Dif.	1.9	0.6	1.7	0.6	0.7	0.6	0.2	0.4	-1.1	0.4	-0.6	0.5

WSF=Wage-and-Salary Formal; WSI= Wage-and-Salary Informal.

Among males, single head-of-household men are the only group that has a positive hours worked differential between the formal and the informal sector. Moreover, this gap increases after the reform. In contrast, married fathers in the informal sector work 1.7 hours per week more than the corresponding group in the formal sector, but the differential decreases after the reform. Finally, it is important to point out that, across all family structure groups considered, informal sector employees have a higher variance of hours worked than formal workers.

Table 10 compares the distribution of workers across thresholds of hours worked for those who have access to social security benefits, with the distribution for those who do

not. As expected, there are very few jobs offering social security benefits that entail working fewer than 40 hours per week. Before the reform, 7% of females and 3% of males in the formal sector work part-time, whereas in the informal sector 21% of women and 9% of men do. This relationship holds across al family structure groups considered. After the reform, however, the proportion of part-time workers in the informal sector decreases across almost all demographic categories. In particular, the probability of part-time informal employment decreases by 12 percentage points among married mothers and single head-of-household women. In contrast, the proportion of agents working part-time in the formal sector increases slightly after the reform for almost all demographic groups. The exceptions are single men, regardless of headship status, where this fraction decreases by 1.5 percentage points.

Regarding full-time employment, Table 10 shows that 71% of females and 64% of males in the formal sector work between 40 and 48 hours per week in 1992, compared to only 50% of men and women in the salaried informal sector. The higher share of full-time workers in the formal sector holds across all family structure groups. Nevertheless, Table 10 also shows that after the reform the fraction of full-time workers in the informal sector increases for all demographic types, especially among females. One exception is married women without children, where this proportion decreases by 2.5 percentage points.

Table 10

Distribution of Workers Across Thresholds of Hours Work by Family Structure Type

		Part Time (H<40)						Full Time (40>=H=<48)						Overtime (H>48)					
		1992		1994		1996		1992		1994		1996		1992		1994		1996	
Females	sector	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se	mean	se
All	WSF	7%	0.4%	7%	0.4%	8%	0.4%	71%	0.7%	74%	0.7%	71%	0.7%	23%	0.7%	19%	0.6%	22%	0.6%
	WSI	21%	0.9%	19%	0.9%	17%	0.9%	49%	1.1%	54%	1.2%	51%	1.2%	30%	1.0%	27%	1.0%	32%	1.1%
Married w/o Children	WSF	9%	1.0%	10%	1.0%	9%	0.9%	71%	1.6%	73%	1.5%	65%	1.5%	20%	1.4%	17%	1.3%	26%	1.4%
	WSI	22%	2.1%	25%	2.4%	25%	2.5%	54%	2.6%	55%	2.7%	51%	2.9%	25%	2.2%	20%	2.2%	24%	2.5%
Married w/ Children	WSF	8%	1.1%	9%	1.1%	10%	1.1%	74%	1.8%	74%	1.7%	70%	1.7%	18%	1.6%	17%	1.5%	20%	1.5%
	WSI	30%	2.7%	32%	3.1%	18%	2.5%	47%	2.9%	47%	3.3%	52%	3.3%	23%	2.5%	21%	2.7%	30%	3.0%
Single Head	WSF	3%	1.4%	4%	1.3%	4%	1.3%	67%	3.8%	74%	2.9%	67%	3.2%	30%	3.7%	22%	2.7%	30%	3.1%
	WSI	23%	5.1%	14%	4.2%	11%	3.3%	40%	5.9%	53%	6.1%	56%	5.2%	37%	5.8%	33%	5.7%	34%	5.0%
Single Dependant	WSF	6%	0.7%	7%	0.7%	7%	0.7%	77%	1.2%	79%	1.1%	77%	1.2%	17%	1.1%	14%	1.0%	16%	1.0%
	WSI	23%	1.9%	20%	1.9%	20%	1.9%	56%	2.3%	62%	2.3%	58%	2.4%	21%	1.8%	19%	1.8%	23%	2.0%
Males																			
All	WSF	3%	0.2%	3%	0.2%	3%	0.2%	64%	0.6%	66%	0.6%	63%	0.6%	34%	0.6%	32%	0.6%	34%	0.6%
	WSI	9%	0.5%	6%	0.4%	8%	0.5%	51%	0.8%	55%	0.9%	52%	0.9%	39%	0.8%	39%	0.8%	40%	0.9%
Married w/o Children	WSF	2%	0.3%	2%	0.3%	3%	0.3%	59%	1.2%	61%	1.1%	60%	1.1%	39%	1.2%	37%	1.1%	37%	1.1%
	WSI	7%	0.9%	5%	0.8%	7%	1.0%	48%	1.8%	52%	1.8%	48%	1.9%	45%	1.8%	43%	1.8%	44%	1.9%
Married w/ Children	WSF	2%	0.3%	2%	0.3%	3%	0.4%	59%	1.2%	61%	1.2%	58%	1.2%	39%	1.2%	38%	1.2%	40%	1.2%
	WSI	6%	0.8%	4%	0.6%	5%	0.7%	47%	1.7%	50%	1.7%	49%	1.7%	48%	1.7%	47%	1.7%	46%	1.7%
Single Head	WSF	5%	1.7%	4%	1.3%	3%	1.2%	65%	3.9%	66%	3.5%	64%	3.4%	31%	3.7%	30%	3.4%	33%	3.3%
	WSI	9%	2.8%	7%	2.7%	5%	2.3%	46%	5.0%	62%	5.1%	51%	5.4%	46%	5.0%	31%	4.9%	44%	5.3%
Single Dependant	WSF	6%	0.7%	4%	0.5%	5%	0.6%	73%	1.2%	76%	1.1%	73%	1.2%	22%	1.2%	20%	1.0%	23%	1.1%
	WSI	15%	1.0%	9%	0.9%	12%	1.0%	56%	1.4%	59%	1.5%	56%	1.6%	29%	1.3%	32%	1.5%	32%	1.5%

WSF=Wage-and-Salary Formal; WSI= Wage-and-Salary Informal.

On the other hand, the share of males in the compliant sector working full-time stays somewhat stable throughout the sample period, regardless of the family structure group considered, whereas the corresponding fraction decreases by 4 and 5.6 percentage points for married women with and without children, respectively.

Finally, Table 10 shows that there is a higher fraction of workers with overtime hours in the non-compliant sector of the economy compared to workers that receive social security benefits. Before the reform, 23% of women and 34% of men in the formal sector work more than 48 hours per week, whereas 30% and 39% of their respective counterparts in the informal sector do. Even though these aggregate proportions stay roughly constant after the reform, their patterns through time vary across family structure groups. The fraction of formal employees working overtime increases across almost all demographic categories, except for single dependent females and married men without children. Among informal workers, on the other hand, the corresponding share increases for married mothers and single dependent men and women, but decreases for the remaining family structure types.

To summarize, there is a higher proportion of full-time workers in the formal than in the informal sector of the economy, whereas the informal sector has a higher fraction of part-time and overtime workers. After the reform, however, the share of part-time workers in the formal sector increases slightly, whereas the informal sector experiences a significant reduction in the fraction of part-time workers and a corresponding increase in the share of full-time and overtime workers. These changes are particularly pronounced among married mothers and single head-of-household women. Finally, it is important to point out that the low proportion of part-time workers in the formal sector of the

economy confirms the existence of employer-set hour thresholds for the receipt of social security benefits, similar to what Buchmueller and Valletta (1999) find for the case of employer-provided health insurance in the United States.

As seen in the Panel A of Figure 5, the changes in the hours or work that occur after the reform may be explained by the increased social security benefits, which drives employees with high valuation for those benefits to stop working part-time without access to employer-provided social security benefits and start working full-time in the formal sector in order to get access to social security benefits for themselves and their families. Nevertheless, to identify the impact of the reform on hours worked it is important to control for the effects of other factor not related to the social security that may have affected the hours of work, such as the business cycle.

3.4 Estimation Strategy and Results.

The empirical approach I use in this chapter follows closely the one used in Chapter 2, where I study the effect of social security contributions on wages. The same identification issue present in that chapter applies here for hours worked. The problem is that the econometrician can not fully observe all the non social security related factors that affect hours worked, making difficult to distinguish between the effects of social security and the effects of other variables that are correlated with both social security and hours worked. One example of these unobserved variables is the health of the worker.

To get around this issue I use a differences-in-differences estimation approach that exploits the temporal change in the legislation introduced by the Colombian social security reform of 1993 and the fact that only a fraction of firms complies with the social

security regulations. That is, by comparing the weekly hours worked by those with social security benefits to the hours worked by those without benefits, and evaluating how they changed from before to after the reform, I can eliminate the bias due to unobserved heterogeneity and leave only the effect of the increased social security contributions on hours worked. This estimation approach is summarized in the following reduced form equation of hours worked:

$$H_i = \beta_0' X_i + \beta_1' d_i + \beta_2' (d_i \times X_i) + \beta_3' S_i + \beta_4' R_i + \beta_5' Y_i + \beta_6' (S_i \times d_i) + \beta_7' (S_i \times R_i) + \beta_8' (S_i \times Y_i) + \upsilon_i \quad (12)$$

Where H_i are weekly hours of work, X_i is a vector of demographic and job characteristics that affect labor supply and wages such as: education, age, age square, marital status, headship status, number of kids under age 6, presence of infants younger than 1 year, an indicator of whether the person is studying, migration status, total number of people in the household, the proportion of employed and unemployed in the household, geographical location, occupation, industry, kind of contract, tenure, firm's size, and place of work. Including hourly wages directly into equation (12) may lead to biased estimates since wages are affected by the availability of social security benefits, as I find in Chapter 2. Instead, I include a set of individual variables that affect earnings. [48]

The business cycle variables are the deviation of real GDP from its trend, d_i, and its interactions with the city, industry, occupation, tenure and skill level variables, $(d_i \times X_i)$.[49] In addition, S_i is a dummy variable indicating whether worker i receives social security benefits through his/her job, Y_i is a vector of year dummies for

[48] This approach is similar to the one used by Cuttler & Madrian (1998) and Buchmueller & Valletta (1999), among others

[49] I estimated the business cycle using the Hodrick-Prescott (1997) filter with lambda=6.25.

1994 and 1996, and R_i is a dummy variable that equals 1 during the 1992-1996 period and zero otherwise and aims to control for the structural changes that occurred in Colombia in 1990.[50] I also include the interaction $(S_i \times d_i)$ to control for sector specific cyclical effect, and the interaction $(S_i \times R_i)$ to control for sector specific effects of the 1990 reforms.

The coefficients of interest are given by the interactions of the social security dummy with the year fixed effects, $(S_i \times Y_i)$, which capture the effect of the social security reform on hours worked. The coefficient for the 1994 interaction measures mostly the effect of the pension reorganization, while the coefficient for the 1996 interaction represents the aggregate effect of the pension and health care reforms. As in the previous two chapters, it is important to point out that the coefficient for the 1994 interaction identifies the effect of the pension reform only if the health care reorganization that followed was not anticipated by the agents. If the agents anticipated the future changes in the health care system and reacted to them before they were actually implemented, then I can only identify the cumulative effect of both reforms and its timing during the reorganization period.

I estimate equation (12) using Eicker White robust standard errors to account for common random effects at the industry sector level. Table 11 summarizes the estimation results separately for men, women, and four family structure categories per gender group that I expect to vary on their valuation of the benefits. In this regressions the omitted category are unskilled married head-of-household workers of rural origin, that are not

[50] The main reforms during this period include the approval of a new constitution, key reforms to the labor market, a major trade reform, and liberalization in direct foreign investment.

attending school, and work without social security benefits in the service sector at firms that have only one employee and no fixed location.

Table 11
Effect of Social Security on Hours Worked
Difference-in-Diffeence Estimation

Females	All	Married w/o Children	Married w/ Children	Single Head	Single Dependant
WSF x Year96	**-2.03** **	**-1.90**	**-2.27** *	**-5.05** **	**0.12**
	0.85	2.27	1.19	2.23	0.90
WSF x Year94	**-0.81**	**-1.74**	**1.27**	**-4.96** **	**0.26**
	0.70	1.71	1.18	1.89	0.68
WSF x Post 1990	**2.40** ***	**3.16** *	**0.86**	**5.53** ***	**0.20**
	0.69	1.53	1.07	1.70	0.58
WSF	**0.27**	**0.58**	**1.44** **	**0.15**	**1.36** **
	0.36	0.42	0.52	0.58	0.39
WSF x GDP	**37.20**	**127.78**	**10.54**	**100.60**	**-48.00** *
	24.70	88.86	57.09	95.24	25.40
year94	**0.13**	**1.31**	**-2.25** ***	**2.46**	**-0.64**
	0.64	1.61	0.76	1.61	0.70
year96	**1.44** *	**2.54**	**1.32**	**3.15** **	**-0.13**
	0.68	2.14	0.97	1.47	0.92
Post 1990	**-1.02**	**-2.08**	**0.37**	**-1.92**	**0.64**
	0.59	1.36	0.80	1.46	0.56
Males					
WSF x Year96	**0.11**	**1.38**	**-0.22**	**1.73**	**0.32**
	0.57	0.94	0.90	2.05	0.66
WSF x Year94	**-0.44**	**0.23**	**-0.52**	**2.05**	**-0.40**
	0.48	0.68	0.97	1.51	0.48
WSF x Post 1990	**0.57**	**0.66**	**0.52**	**-0.55**	**-0.21**
	0.46	0.79	0.64	1.45	0.37
WSF	**0.12**	**-0.30**	**-0.30**	**0.76**	**0.99** **
	0.33	0.30	0.42	0.56	0.35
WSF x GDP	**-7.39**	**-68.46** **	**17.44**	**-7.93**	**-23.72**
	15.21	29.19	31.73	72.07	24.68
year94	**-0.06**	**-0.92** **	**-0.09**	**-2.22** *	**0.47**
	0.42	0.39	0.78	1.13	0.28
year96	**-0.51**	**-1.72** **	**-0.45**	**-1.86**	**-0.06**
	0.44	0.73	0.86	1.63	0.43
Post 1990	**0.60**	**0.70**	**0.95**	**1.62**	**0.47** **
	0.38	0.53	0.56	1.27	0.19

WSF=Wage-and-Salary Formal dummy, * p<.1; ** p<.05; *** p<.01

Although Table 11 only reports the coefficients for the differences-in-differences variables, in these regressions most of the coefficients for the demographic, industry, city, occupation, and firm characteristics are statistically different from zero and have the

expected signs. Furthermore, the variables that control for cyclical effects at the sector, city, industry, occupation, tenure, and skill level also have jointly statistically significant coefficients.

On each panel of Table 11, the first two rows compare the hours worked differential between sectors for the years 1996 and 1994 to the corresponding difference in 1992, and measure the effect of the reform on the relative hours of work in the formal sector. In addition, row 3 shows the effect of the 1990 reforms on the hours of work differential, row 4 shows the time invariant effect of social security contributions on hours worked, and row 5 represents the effect of the business-cycle on the hours of work differential. Finally, rows 6, 7, and 8 show the year fixed effects and the effect of the 1990 reforms common to both sectors.

The coefficient of the formal sector dummy, in Column (1), shows that females that have access to social security benefits work on average 0.27 hours more than those without access to it. Formal males, on the other hand, only work 0.12 hours more than their counterparts in the informal sector of the economy. This positive effect of social security on hours worked holds across almost all family structure groups considered and is related to the fact that formal firms rarely offer social security benefits to part-time employees. This first difference estimate is likely to be biased, however, since I can not isolate the effects of social security and the effects of other unobserved variables that are correlated with both social security and hours worked.

Nevertheless, the differences-in-differences coefficients should eliminate the bias due to unobserved heterogeneity and leave only the effect of the social security reform on hours worked. The coefficient for the year 1994 suggests that during the first part of the

reform there is a 0.81 hours relative fall in the weekly hours worked by females that have access to employer-provided social security benefits compared to the hours of work of those without it. This effect progresses in such a way that by the year 1996 the work week for females in the formal sector is 2 hours shorter relative to the work week of those in the informal sector of the economy.

Table 11 also shows that married women with children and single head-of-household women are the demographic categories that experience the largest effects. Married mothers in the formal sector decrease their relative weekly work by 2.3 hours between 1992 and 1996, whereas single head-of-household women that have access to employer-provided social security drop their hours of work by 5 hours relative to the weekly hours of those without access to benefits. These effects are equivalent to a 5% and 10% reduction in the weekly work of these two family structure groups, respectively. Similarly, the hours worked by formal married women without children decrease by 1.9 hours relative to their counterparts in the informal sector. On the other hand, the social security reform increases the relative hours of work of single dependent females in the compliant sector by 0.12 hours, but this effect is not significantly different from zero. It is important to point out that for all of these groups the effects occurs mostly during the first part of the reform.

Although of a smaller magnitude, the effect of the social security reorganization is the opposite for males. Column (1) in Table 11 shows that between 1992 and 1996 men in the compliant sector of the economy increase their weekly hours of work by 0.11 hours compared to the hours worked by those in the non compliant sector. Among men, married males without children and single head-of-household men are the family structure groups

that experience the largest effects. Formal sector men in a childless couple increase their relative weekly work by 1.38 hours after the reform, whereas single head-of-household men that have social security benefits raise their hours of work by 1.73 hours relative to their counterparts in the informal sector of the economy. For both groups these effects are roughly equivalent to a 3% increase in their weekly hours of work. On the other hand, the relative hours worked by single dependent males in the formal sector increases by only .32 hours after the reform, while married fathers in the formal sector are the only group, among men, where the relative hours of work decrease, but just by 0.22 hours. It is important to highlight the fact that none of the effects for men are statically different from zero.

To summarize, I find that the social security reform has a negative effect on the hours of work of women in the formal sector, reducing their weekly work by 2 hours relative to the weekly hours of those in the informal sector of the economy. The effect is particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effect is not statistically significant.

The changes in the distribution of workers across thresholds of hours work, shown in Table 10, can help to clarify where the relative reduction in the hours worked by formal females is coming from. The top panel of Table 10 shows that the proportion of females in the formal sector that work part-time increases 1 percentage point after the reform, with a consequent reduction in both full-time and overtime hours. Simultaneously, women in the informal sector experience a 4 percentage point reduction in the fraction of part-time workers and a corresponding increase in the share of full-time and overtime

workers. This effect is particularly important among married mothers and single head-of-household women, for whom the proportion of part-time workers decreases by 12 percentage points. For married mothers this translates into an increase in the fraction of full-time and overtime workers, whereas for single head-of-household women it only translates into an increase in the proportion of full-time workers.

Moreover, I find similar results in Chapter 2 where I estimate the fraction of social security contributions that employers pass on to workers in the form of lower wages. My results indicate that the hourly wages of female workers with access to social security benefits decrease by 5% relative to the wages of those without access to the benefits. In contrast, the hourly earnings of male workers in the wage-and-salary formal sector increase by 2% relative to the earnings of those in the wage-and-salary informal sector. Similar to the hours of work results, the reduction in the relative wages of formal sector workers is particularly important among married mothers and single head-of-household women, whereas for married women without young children, single dependent women, and men in any family structure group the effect is not significantly different form zero.

The effects on wages and hours worked are also linked to a change in the composition of employment sectors. In Chapter 1, I study the effect of the social security reorganization on the employment sector choice of workers. My results indicate that, among females, the reform generates a 6 percentage point increase in the proportion formal workers, a 2.5 percentage point reduction in both self-employment and non-market participation, and a 1 percentage point fall in salaried informality. On the other hand, the reform increases males' formal employment probability by only 3 percentage points, reduces salaried informality by 2.5 percentage points, decreases self-employment

by 0.7 percentage points, and has an insignificant effect on males' non-market participation. Among females, my results show that for married women the reform is the basis for a transition from non-market participation and self employment into formality, specially for those with young children. Conversely, for single head-of-household and single dependent women the reform causes, in addition to the previous changes, a shift from salaried informality into formality.

The previously mentioned changes in hours, wages, and employment sector choice are all interconnected. Before the reform, some married mothers and single head-of-household women, who usually supply low hours of work, did not have an incentive to work full-time in either the formal or the informal sector. Furthermore, since formal firms rarely offer benefits to part-time employees, individuals in these two demographic groups either worked part-time in the salaried informal and self employment sector or did not participate in the market at all. The social security reform, however, increased both the quantity and the quality of pension and health care benefits. As mentioned in section 3.2, this generates a jump on the workers budget constraint at the full-time threshold, where the height of this jump depends on the value that workers give to the benefits. This effect turns out to be particularly important for women on these two family structure groups, due to their higher valuation of the benefits, their higher degree of risk aversion, and their more elastic labor supply.[51] Therefore, the reform made some married mothers and single head-of-household women that would otherwise be working part-time in the informal sector, or not participating in the market, to work full-time in the formal sector at relative lower wages in order to get access to benefits for them and their families. This generated a reduction in the proportion of part-time workers in the informal sector among

[51] See Deleire and Levy (2004), Hersch (1998), and Jianakoplos and Bernasek (1998).

women in these two family structure groups, and at the same time made the pool of workers with social security benefits increasingly concentrated among those who work just enough hours to get access to the benefits. These two effects drove down the relative hours of work of married mothers and single head-of-household women in the formal sector.

My results for women differ from the findings of Cutler & Madrian (1998) in their study of the hours worked responses to rising health insurance cost in the United States. They find that the rapid growth in health insurance in the 1980s led to a 3% increase in hours of work among workers who received employer-provided health insurance relative to those without employer-provided health insurance. They argue that this occurs because health insurance is a quasi-fixed cost. Therefore, a higher the cost of providing the benefit increases the incentives for firms to substitute hours per worker for number of workers. In Colombia, however, social security taxes are computed as a percentage of monthly wages. In this case, an increase in social security contributions affects the per hour cost of labor, while it does not affect the fixed cost of hiring someone. Therefore, the rapid growth in social security contributions that Colombia experienced during 1994 and 1995, which was partially transferred on to female workers in the form of lower wages, drove formal sector firms to substitute increased number of workers for fewer hours per employee.

3.5 Conclusions

In this chapter I estimate the aggregate effect of social security contributions on the length of the work week, controlling for individual characteristics and the effect of

the business cycle. I find that the social security reform has a negative effect on the hours of work of women in the formal sector, reducing their weekly work by 2 hours relative to the weekly hours of those in the informal sector of the economy. I also find that the effect is particularly important among married mothers and single head-of-household women, whereas for married women without children, single dependent women, and men in any family structure group the effect is not statistically significant. The effect on women is mostly explained by a reduction in the proportion of females that work part-time in the informal sector, who switched to full-time jobs in the formal sector in order to get access to social security benefits for themselves and their families.

An important caveat, however, is that the Colombian National Household Survey only has information on the usual hours worked in all jobs, but not on the number of jobs or the average hours worked on each job. As mentioned by Cutler Madrian (1998), the potential for multiple job holdings may confound the results. Therefore, it is important to explore the incidence of multi-job holding in Colombia.

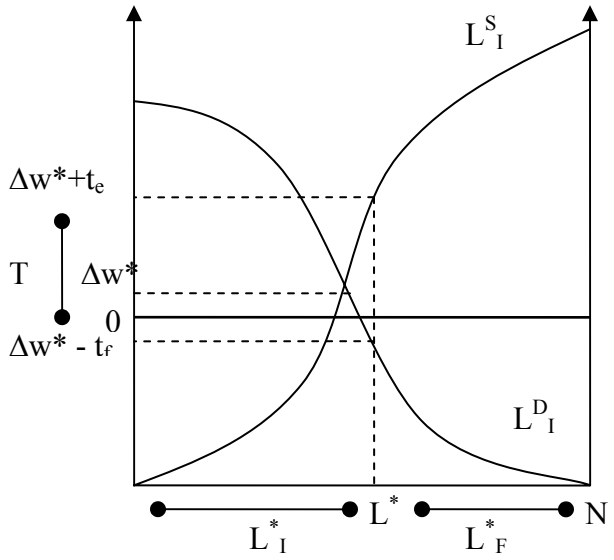
In addition, rather than being able to vary their hours of work continuously, individuals could only be able to choose among a small number of hour levels offered by their employers. Therefore, an alternative approach that could increase our knowledge of the effects of social security on hours work would be to estimate a discrete model of hours work, where the worker chooses among four outcome categories: non-market participation, part-time, full-time, and overtime, and at the same time among formal or informal employment. This is a topic of ongoing research.

Finally, this chapter has concentrated on the effects of the social security reform on the labor supply of prime age workers. Another interesting question is to what extent

pension and health insurance availability affect the retirement decision of workers. In this area it would be important to take into consideration the different retirement ages for men a women present in Colombia. Furthermore, it would be interesting to know how informal workers support themselves in retirement, the post-retirement health insurance options of different types of workers, and how all these factors affect their retirement decisions. These are topics for future research.

Appendix

Figure 1.a
Labor Market Equilibrium



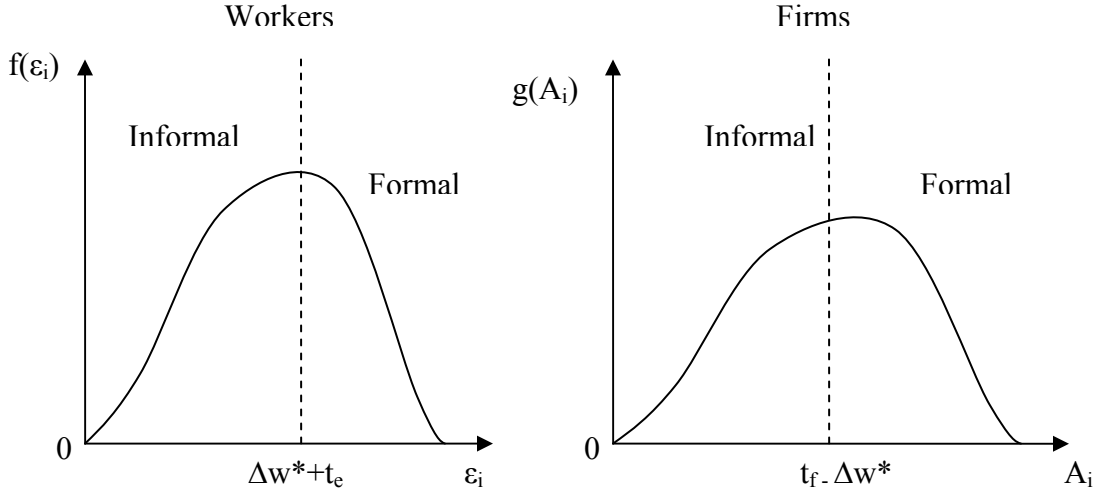


Figure 2.a

Effect of a Generalized Increase in the Valuation of the Benefits on Employment Sector Choice

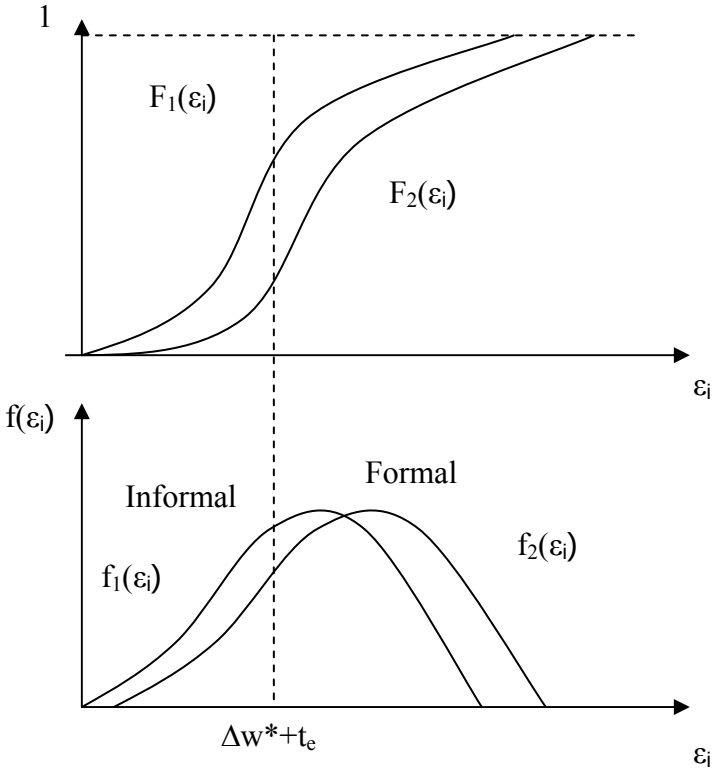


Table 1.a

Wald Test of Significance of the Coefficients Across Equations

	Females												Males											
	All		Married No Children		Married Children		Single Head		Single Dependant		Non-Single Dependant		All		Married No Children		Married Children		Single Head		Single Dependant		Non-Single Dependant	
	chi2	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**	**chi2**	**P>chi2**
GDP	40	0.00	16	0.00	22	0.00	10	0.02	112	0.00	4	0.31	96	0.00	110	0.00	14	0.00	12	0.01	18	0.00	13	0.00
Post 1990 Dummy	34	0.00	39	0.00	10	0.02	54	0.00	5	0.20	15	0.00	5	0.16	13	0.00	4	0.32	13	0.01	10	0.02	13	0.00
Year 1994	49	0.00	14	0.00	51	0.00	36	0.00	46	0.00	5	0.16	41	0.00	73	0.00	31	0.00	16	0.00	10	0.02	2	0.50
Year 1996	127	0.00	93	0.00	178	0.00	21	0.00	28	0.00	3	0.38	118	0.00	58	0.00	12	0.01	15	0.00	46	0.00	18	0.00
Age	4271	0.00	1624	0.00	1343	0.00	250	0.00	1432	0.00	1362	0.00	1993	0.00	2038	0.00	435	0.00	296	0.00	930	0.00	299	0.00
Age Sqr	3109	0.00	1627	0.00	1204	0.00	137	0.00	1206	0.00	793	0.00	1833	0.00	2529	0.00	278	0.00	252	0.00	755	0.00	259	0.00
Basic	132	0.00	9	0.03	26	0.00	24	0.00	5	0.14	2	0.55	8	0.05	7	0.07	16	0.00	4	0.31	19	0.00	6	0.11
High School	197	0.00	41	0.00	110	0.00	3	0.46	14	0.00	9	0.03	42	0.00	3	0.36	2	0.63	19	0.00	52	0.00	4	0.22
Some College	44	0.00	31	0.00	7	0.07	9	0.02	17	0.00	3	0.42	17	0.00	2	0.63	2	0.60	3	0.34	24	0.00	4	0.29
College	16	0.00	17	0.00	58	0.00	3	0.38	25	0.00	17	0.00	66	0.00	46	0.00	7	0.07	3	0.33	52	0.00	2	0.57
New Migrant	113	0.00	52	0.00	26	0.00	4	0.31	6	0.12	23	0.00	173	0.00	10	0.02	110	0.00	10	0.02	4	0.23	17	0.00
1 year Migrant	88	0.00	29	0.00	102	0.00	16	0.00	19	0.00	11	0.01	8	0.04	9	0.03	13	0.00	6	0.12	29	0.00	7	0.06
Rural Origin	256	0.00	46	0.00	20	0.00	8	0.05	25	0.00	29	0.00	21	0.00	25	0.00	7	0.08	54	0.00	103	0.00	29	0.00
Studing	726	0.00	57	0.00	232	0.00	62	0.00	1615	0.00	55	0.00	1446	0.00	174	0.00	210	0.00	194	0.00	304	0.00	64	0.00
Household Characteristics																								
Expenditure Unit	377	0.00	1340	0.00	112	0.00	101	0.00	362	0.00	27	0.00	1476	0.00	140	0.00	412	0.00	26	0.00	299	0.00	38	0.00
Num Emp	1618	0.00	4564	0.00	26511	0.00	1581	0.00	7900	0.00	697	0.00	9754	0.00	5324	0.00	1209	0.00	381	0.00	6113	0.00	319	0.00
Num Unemp	1130	0.00	277	0.00	54	0.00	116	0.00	1425	0.00	76	0.00	4078	0.00	2178	0.00	1587	0.00	155	0.00	1342	0.00	1046	0.00
City																								
B/manga	198	0.00	30	0.00	8	0.05	25	0.00	30	0.00	23	0.00	63	0.00	13	0.00	39	0.00	61	0.00	87	0.00	47	0.00
Bogota	1732	0.00	2189	0.00	374	0.00	191	0.00	1922	0.00	33	0.00	792	0.00	1186	0.00	994	0.00	92	0.00	104	0.00	325	0.00
Manizales	244	0.00	46	0.00	92	0.00	1304	0.00	771	0.00	19	0.00	2504	0.00	19	0.00	275	0.00	68	0.00	287	0.00	61	0.00
Medellin	214	0.00	115	0.00	151	0.00	7	0.08	102	0.00	13	0.01	63	0.00	57	0.00	4	0.28	18	0.00	3	0.34	4	0.22
Cali	495	0.00	596	0.00	477	0.00	28	0.00	75	0.00	44	0.00	2818	0.00	61	0.00	0	0.93	26	0.00	1447	0.00	20	0.00
Pasto	3326	0.00	1731	0.00	292	0.00	72	0.00	1684	0.00	318	0.00	1911	0.00	1307	0.00	4585	0.00	389	0.00	2268	0.00	226	0.00
v/cio	711	0.00	7233	0.00	173	0.00	133	0.00	157	0.00	160	0.00	416	0.00	620	0.00	1406	0.00	174	0.00	75	0.00	23	0.00
pereira	407	0.00	101	0.00	137	0.00	42	0.00	20	0.00	75	0.00	249	0.00	139	0.00	34	0.00	22	0.00	504	0.00	528	0.00
cucuta	9	0.03	61	0.00	11	0.01	5	0.18	11	0.01	112	0.00	34	0.00	159	0.00	3	0.45	23	0.00	64	0.00	12	0.01
city2gdp	232	0.00	32	0.00	10	0.02	32	0.00	32	0.00	31	0.00	109	0.00	17	0.00	42	0.00	60	0.00	139	0.00	35	0.00
city3gdp	2231	0.00	2649	0.00	392	0.00	262	0.00	2695	0.00	56	0.00	2045	0.00	1468	0.00	1649	0.00	93	0.00	217	0.00	295	0.00
city4gdp	91	0.00	32	0.00	207	0.00	1500	0.00	1227	0.00	33	0.00	4559	0.00	69	0.00	526	0.00	86	0.00	351	0.00	71	0.00
city5gdp	310	0.00	214	0.00	193	0.00	9	0.04	99	0.00	21	0.00	225	0.00	131	0.00	9	0.03	18	0.00	12	0.01	6	0.13
city6gdp	623	0.00	646	0.00	521	0.00	21	0.00	92	0.00	68	0.00	3612	0.00	230	0.00	8	0.05	22	0.00	1073	0.00	36	0.00
city7gdp	1964	0.00	1338	0.00	864	0.00	62	0.00	1714	0.00	266	0.00	2133	0.00	836	0.00	5361	0.00	417	0.00	2773	0.00	225	0.00
city8gdp	866	0.00	7871	0.00	100	0.00	100	0.00	192	0.00	180	0.00	441	0.00	750	0.00	1665	0.00	208	0.00	54	0.00	27	0.00
city9gdp	447	0.00	117	0.00	331	0.00	48	0.00	33	0.00	91	0.00	80	0.00	106	0.00	31	0.00	26	0.00	420	0.00	594	0.00
city10gdp	10	0.02	53	0.00	12	0.01	4	0.25	10	0.02	111	0.00	32	0.00	175	0.00	3	0.39	23	0.00	58	0.00	12	0.01
edu2gdp	63	0.00	10	0.02	22	0.00	19	0.00	8	0.04	2	0.53	7	0.09	14	0.00	18	0.00	2	0.50	24	0.00	5	0.16
edu3gdp	116	0.00	33	0.00	82	0.00	4	0.28	27	0.00	4	0.22	66	0.00	3	0.34	5	0.15	14	0.00	67	0.00	5	0.19
edu4gdp	15	0.00	10	0.02	3	0.45	3	0.32	34	0.00	6	0.10	27	0.00	6	0.11	3	0.38	4	0.26	31	0.00	2	0.59
edu5gdp	46	0.00	22	0.00	46	0.00	7	0.08	48	0.00	12	0.01	127	0.00	74	0.00	16	0.00	4	0.25	53	0.00	5	0.21
Joint Test of Significance																								
Post 1990 Dummy	383	0.00	127	0.00	189	0.00	57	0.00	67	0.00	31	0.00	212	0.00	234	0.00	47	0.00	29	0.00	96	0.00	21	0.00
Age	2E+04	0.00	3E+03	0.00	1E+03	0.00	1E+03	0.00	3E+03	0.00	2E+03	0.00	5E+03	0.00	6E+03	0.00	3E+03	0.00	4E+02	0.00	4E+03	0.00	4E+02	0.00
Education	1683	0.00	521	0.00	552	0.00	191	0.00	578	0.00	122	0.00	547	0.00	395	0.00	170	0.00	272	0.00	161	0.00	85	0.00
Migration	154	0.00	71	0.00	137	0.00	23	0.00	29	0.00	91	0.00	276	0.00	33	0.00	123	0.00	30	0.00	54	0.00	21	0.00
Expenditure Unit	5E+04	0.00	1E+04	0.00	4E+04	0.00	6E+03	0.00	2E+04	0.00	3E+03	0.00	4E+03	0.00	2E+04	0.00	1E+04	0.00	6E+03	0.00	4E+04	0.00	4E+03	0.00
City	5E+05	0.00	2E+06	0.00	1E+06	0.00	2E+07	0.00	7E+05	0.00	3E+05	0.00	5E+05	0.00	3E+05	0.00	2E+06	0.00	3E+07	0.00	8E+06	0.00	4E+05	0.00
City x GDP	7E+05	0.00	2E+06	0.00	1E+06	0.00	2E+07	0.00	7E+05	0.00	3E+05	0.00	7E+05	0.00	5E+05	0.00	3E+06	0.00	1E+07	0.00	3E+06	0.00	6E+05	0.00
Edu x GDP	1536	0.00	523	0.00	392	0.00	153	0.00	606	0.00	105	0.00	1035	0.00	469	0.00	227	0.00	327	0.00	184	0.00	112	0.00

Table 2.a

Hausman Tests of Independence of Irrelevant Alternatives Assumption

	Females					Males				
	Omitted	**chi2**	**df**	**P>chi2**	**evidence**	**Omitted**	**chi2**	**df**	**P>chi2**	**evidence**
All	WSF	272.06	93	0.00	against Ho	NMP	6.78	94	1.00	for Ho
	WSI	92.43	93	0.50	for Ho	WSI	17.80	94	1.00	for Ho
	SLF	66.11	93	0.98	for Ho	SLF	32.25	93	1.00	for Ho
Married	WSF	-24.53	78	1.00	for Ho	NMP	1.43	78	1.00	for Ho
No	WSI	-2.48	77	1.00	for Ho	WSI	2.60	78	1.00	for Ho
Children	SLF	13.66	78	1.00	for Ho	SLF	13.16	77	1.00	for Ho
Married	WSF	54.48	78	0.98	for Ho	NMP	0.22	77	1.00	for Ho
Children	WSI	3.82	78	1.00	for Ho	WSI	5.54	77	1.00	for Ho
	SLF	26.67	78	1.00	for Ho	SLF	-2.68	77	1.00	for Ho
Single	NMP	1.67	76	1.00	for Ho	NMP	0.61	77	1.00	for Ho
Head	WSI	-1.63	77	1.00	for Ho	WSI	3.06	76	1.00	for Ho
	SLF	5.56	76	1.00	for Ho	SLF	7.65	77	1.00	for Ho
Single	WSF	19.18	77	1.00	for Ho	WSF	30.23	78	1.00	for Ho
Dependant	WSI	3.06	77	1.00	for Ho	WSI	15.05	78	1.00	for Ho
	SLF	3.27	77	1.00	for Ho	SLF	9.15	78	1.00	for Ho
Non-Single	WSF	5.24	78	1.00	for Ho	NMP	0.89	78	1.00	for Ho
Dependant	WSI	2.18	77	1.00	for Ho	WSI	4.34	77	1.00	for Ho
	SLF	1.84	78	1.00	for Ho	SLF	3.01	78	1.00	for Ho

Ho: Odds(Outcome-J vs Outcome-K) are independent of other alternatives

WSF= Formal; WSI= Informal; SLF= Self employment; NMP= Non-market Participation

Bibliography

Alm, J., Lopez, H., 2002. Payroll Taxes in Colombia. *Mission of Public Income. Fedesarrollo*, Bogotá.

Asofondos , 2001. Siete Años del Régimen de Ahorro Individual con Solidaridad. *Boletín Asofondos* No 012, July.

Bajtelsmit, V., Bernasek, A., 1996. Why Do Women Invest Differently Than Men?. *Financial Counseling and Planning*, Vol. 7.

Bell, L. 1997. The impact of Minimum Wages in Mexico and Colombia. *Journal of Labor Economics,* Vol.15.

Buchmeller, T., Valletta, R. 1999. The effect of Health Insurance on Married Female Labor Supply. *The Journal of Human Resources*, Vol. 34, No 1.

Castells, M., Portes, A., 1989. Work Underneath: The Origins, Dynamics, and Effects of the Informal Economy. In: A.Portes, M. Castells, and L. Benton (Eds): *The informal Economy: Studies in Advanced and Less developed Countries*. Johns Hopkins University Press.

Currie, J., Madrian. B., 1999. Health, Health Insurance and the Labor Market, in: Orley Ashenfelter and David Card, (eds.), *Handbook of Labor Economics*, Vol. 3C, Amsterdam: Elsevier Science, 3309-3416.

Cutler, D., Madrian, B., 1998. Labor Market Responses to rising health insurance costs: evidence on hours worked. *RAND Journal of Economics*, Vol. 29, No 3, autumn

DeLeire, T. Levy, H., 2004. Worker Sorting and the Risk of Death on the Job. *The Journal of Labor Economics*, Vol. 22, No 4, October.

Edwards, S., Cox, A., 2002. Social Security Privatization Reform and Labor Markets: The case of Chile. *NBER Working Paper* No 8924.

Farne, S., 2003. Empleo y Seguridad Social en Colombia. in: Carrasco E. (Ed.), *Diez años del sistema de seguridad social colombiano: evaluación y perspectivas*, Universidad Externado de Colombia, Bogotá.

Florez, C., 2002. The Function of the Urban Informal Sector in Employment. *Documento CEDE* 1001-04, Universidad de los Andes, April.

Fullerton, D., Metcalf, G., 2002. Tax Incidence, in: *Handbook of Public Economics*, North-Holland, Amsterdam. Vol. 4, Ch 26.

Gentry, W., Hubbard, G., 2000. Tax Policy and Entrepreneurial Entry. *The American Economic Review*, Vol. 90, No 2, May.

Gruber, J., Krueger, A. 1991. The Incidence of Mandated Employer-Provided Insurance: Lessons from Workers' Compensation Insurance. In David Bradford, ed., *Tax Policy and the Economy*. Cambridge: MIT Press.

Gruber, J., 1994. The Incidence of mandated Maternity Benefits. *American Economic Review*, Vol. 84, No 3, June.

Gruber, J., 1997. The incidence from Payroll taxation: Evidence From Chile. *Journal Of Labor Economics*, Vol. 15, No 3.

Gruber, J., 1998. Health Insurance and the Labor Market. *NBER Working Paper* 6762, October.

Gruber, J., 2000. Payroll Taxation, Employer Mandates, and the Labor Market: Theory, Evidence and Unanswered Questions, in: W. Alpert and Woodbury S. (Eds.), *Employee Benefits and Labor Markets in Canada and the Unites States*. W.E. Upjohn Institute of Employment Research.

Gruber, J., Madrian. B., 2002. Health Insurance, Labor Supply, and Job Mobility: A critical review of the literature. *NBER Working Paper* 8817, March.

Hamermesh, D., 1979. New Estimates of the Incidence of the Payroll Tax. *Southern Economic Journal*, Vol. 45, No 4.

Harris, J., Todaro, M., 1970. Migration, Unemployment and Development: A two sector Analysis. *American Economic Review*, Vol. 60, No 1.

Hausman, J., McFadden, D., 1984. A Specification Test for the Multinomial Logit. *Econometrica*, Vol.52.

Heckman, J., Pages C., 2003. Law And Employment: Lessons From Latin America and the Caribbean. *NBER Working Paper* 10129, December.

Hersch, J., 1998. Compensating Differentials for Gender Specific Job Injury Risks, *American Economic Review*, Vol. 88, No. 3, June.

Hodrick, R., Prescott E., 1997. Postwar US Business Cycles: An Empirical Investigation, *Journal of Money, Credit and Banking*, Vol. 29.

James, E., 2000. Old Age Protection for the Uninsured: What are the Issues?. In: *Shielding the Poor*, ed. Nora Lusting, Inter-American Development bank and Brooking Insitution Press.

Jianakoplos, N., Bernasek, A., 1998. Are Women More Risk Averse?. *Economic Inquiry*, Vol. 36, No 4, October.

Kesselman, J. 1997. General Payroll Taxes: Economics, Politics, and Design. Canadian Tax Foundation, Toronto.

Kugler, A., 2000. The Incidence of Job Security Regulations on Labor Market Flexibility and Compliance in Colombia: Evidence from the 1990 Reform. *Inter-American Development bank, Research Network Working Paper* No R-393.

Kugler, A., Kugler, M. 2003. The Labor Market Effects of Payroll Taxes in a Middle-Income Country: Evidence From Colombia. *IZA Discussion Paper* No 852.

Lopez, H., 2003. Contribuciones e Impuestos Sobre la Nomina en Colombia, in *Mision de Ingreso Publico*, Enero.

Lora, E., Henao, M., 1997. Colombia: The Evolution and Reform of the Labor Market. Labor Market in Latin America: Combining Social Protection with Market flexibility, Brookings Institution Press.

MaCurdy, T., Rapoport, D., 2003. Understanding Health-Insurance Coverage of Low-Skilled Workers in the US and in California: Trading Wages for Insurance. Sphere Institute, Study realized for the California HealthCare Foundation, January.

Maloney, W., Nunez, J., 2001. Measuring the Impact of Minimum Wages: Evidence from Latin America. *World Bank Policy Research Working Paper* No 2597, April.

Maloney, W., 2004. Informality Revisited. *World Development*, 2004, Vol. 32, issue 7.

Marrufo, G. 2001. The Incidence of Social Security Regulation: Evidence from the Reform in Mexico. Ph.D Dissertation. University of Chicago.

Mincer, J., 1976. Unemployment Effects of Minimun Wages. *Journal of Political Economy,* Vol. 84, No 4 pt. 2, August.

Ministerio del Trabajo y Seguridad Social 1997. La no Afiliación y la Evasión en el Sistema General de Riesgos Profesionales por la Forma de Contratación y Propuesta para un Régimen Sancionatorio. Informe Tecnico, Marzo.

Mondino, G., Montoya, S., 2000. The Effects of Labor Market Regulations on Employment Decisions by Firms: Empirical Evidence for Argentina. *Inter American development Bank, Research Network Working Paper* No R-391.

Moore, R., 1983. Self employment and the Incidence of the Payroll Tax. *National Tax Journal*, Vol. XXVI.

Oi, W., 1962. Labor as a Quasi-Fixed Factor. *Journal of Political Economy*, Vol. 60, No 6, December.

Olson, C. 2002. Do workers Accept Lower Wages in Exchange for health Benefits?. *Journal of Labor Economics*, Vol. 20, No. 2, pt. 2.

Plaza, B. 1999. Afiliación de población pobre al sistema de salud: el caso Colombiano, Fundación Corona. Bogotá.

Rosen, S., 1986. The Theory of Equalizing Differences. In: Ashenfelter and Layard (eds.), *Handbook of Labor Economics*, Vol. 1, Ch 12.

Schuetze, H., 2000. Taxes, economic conditions and recent trends in male self employment: a Canada- US Comparison. *Labour Economics* No 7.

Schuetze, H., Bruce, D., 2004. Tax Policy and Entrepreneurship. S*wedish Economic Policy Review* ,Vol. 11, No 2.

Stabile, M., 2004. Payroll Taxes and The Decision to be Self-Employed. *International Tax and Public Finance,* Vol. 11, No. 1.

Summers, L. 1989. Some Simple Economics of Mandated Benefits. *American Economic Review,* Vol. 79, No 2.

Tockman, V., 1992. The informal sector in Latin America,: From underground to legality. In: Tockman V (Ed). B*eyond Regulation. The informal Economy in Latin America*. Lynne Rienner Publishers.

Uribe, C. 2002. La Reforma de Pensiones en Colombia y la Equidad de Genero. *Serie Mujer y Desarrollo,* No 41, CEPAL, Octubre.

Yamada, G., 1996. Urban Informal Employment and Self Employment in Developing Countries: Theory and Evidence. *Economic Development and Cultural Change,* Vol. 44.

VITA

Andres Jose Vargas was born in Bogotá, Colombia on October 4, 1974, the son of Eduardo Vargas and Maria Eugenia Gallo. After completing his work at Saint Viator High School, Bogotá, Colombia, in December 1991, he entered Los Andes University in Bogotá, Colombia, where he received a Bachelor of Arts degree in Economics in March 1997. He continued his studies and obtained a Master of Arts degree in Economics from Los Andes University in March 1998, while at the same time working as a junior researcher at the Agricultural Studies Center, Bogotá, Colombia. Throughout that period, he also coauthored two articles and a book on agricultural trade policy in Colombia during the 1990's. Following his graduation from Los Andes University, he was hired as a macroeconomic policy advisor for the Colombian Ministry of Finance and Public Credit in Bogotá, Colombia. After that, he attended the Midi-Pyrénées School of Economics, Toulouse, France, where he received the degree of Master of Arts in natural resources and agricultural economics in June 2001. He published his master thesis later that year. In September 2001 he entered the Graduate School of The University of Texas at Austin.

Permanent Address: Calle 128B No. 52A-45 Apt 201, Bogota, Colombia.

This Dissertation was typed by the author